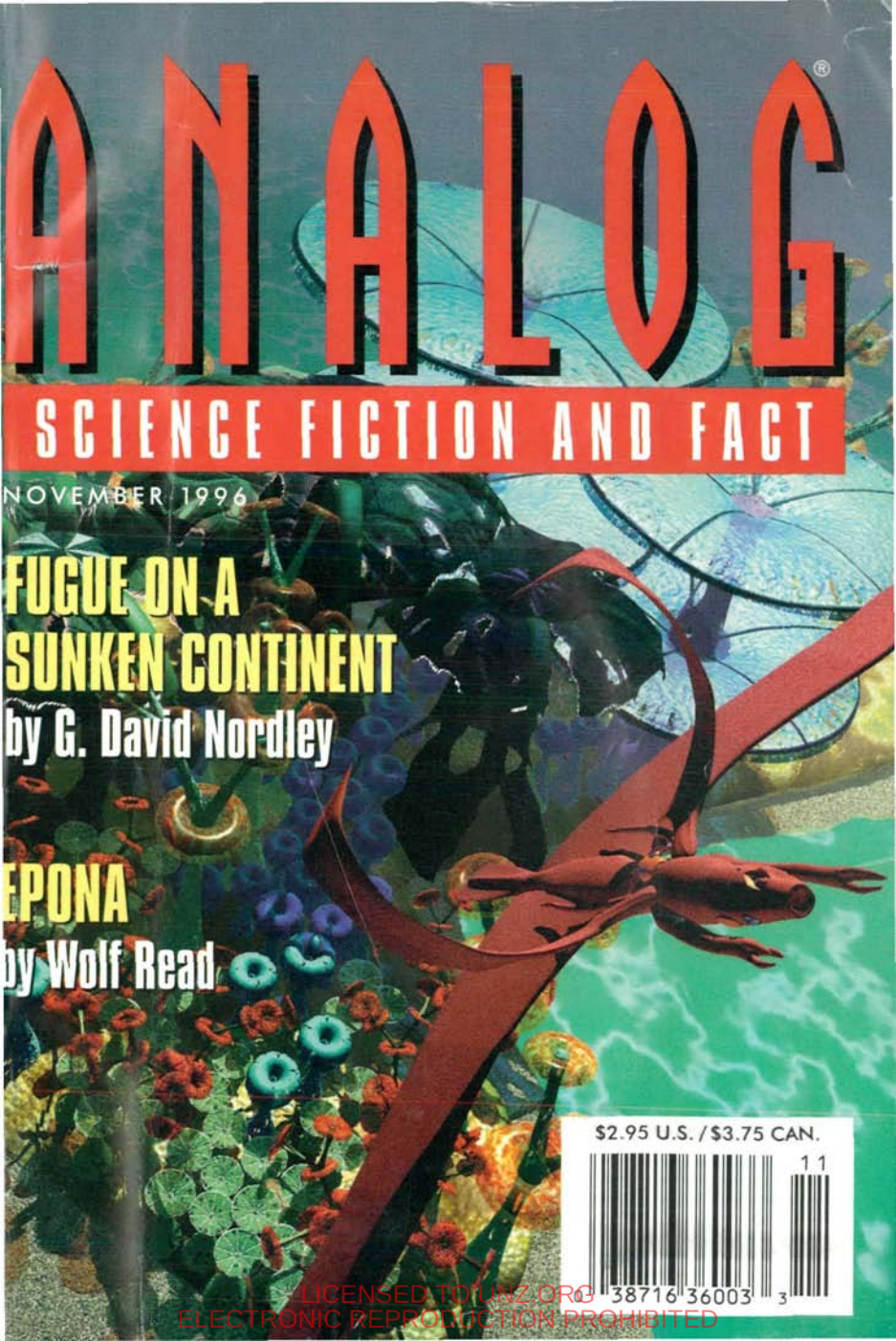

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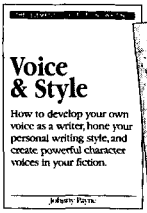
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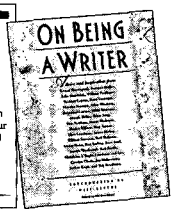

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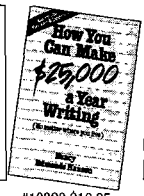

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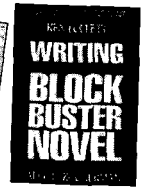

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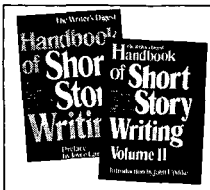

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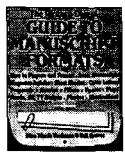

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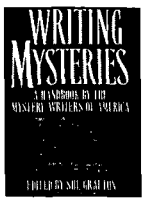

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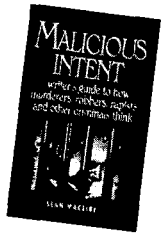

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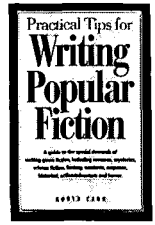

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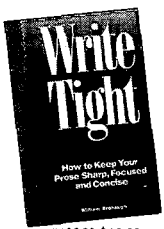

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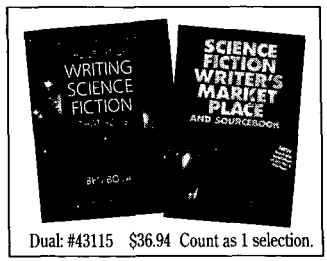

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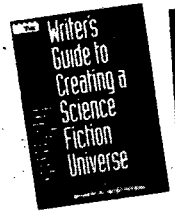

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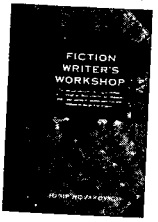

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The Odds Are for Murder

WIN, LOSE OR DIE

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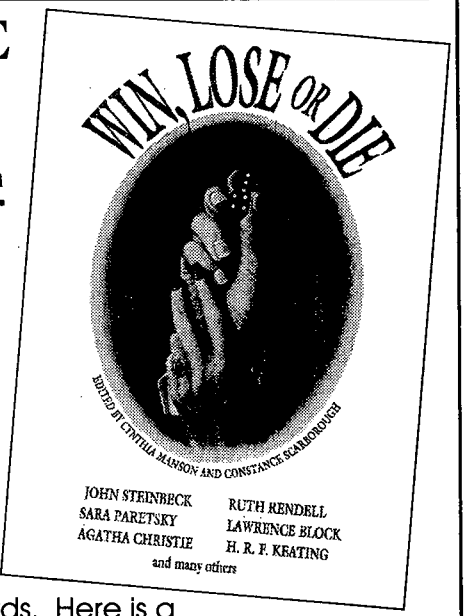

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THE DARK SIDE OF CLARKE'S LAW

Probably everyone who's been reading science fiction for even a moderate time is familiar with the observation often called Clarke's Law, after author Arthur C. Clarke: "Any sufficiently advanced technology is indistinguishable from magic."

What Arthur originally had in mind, I suspect, was that an alien culture—or a future human culture—that had had much more time to develop might use technology whose operating principles would be so unobvious to us that they might as well be supernatural. By the same token, our own technology might look like magic to members of a culture that had remained isolated and at a Stone Age level of development somewhere on Earth. Anthropologists have had a few occasions, such as first contact with the Tasaday, to verify that this actually happens.

Until recently, I tended to think of Clarke's Law as simply an academic observation about what was likely to happen if we ever encountered a civilization at a very different level of technological development. It didn't seem to have any particular practical significance, or beneficial or detrimental consequences, unless and until that happened. Recently, however, it has occurred to me that Clarke's Law *may* have practical consequences—not necessarily good—and much closer to home.

This realization hit me back in January, when I was being interviewed by Canadian journalist Joe Woodard for an article he was doing for the magazine *Alberta Report*. His article ran in the January 22 issue, under the title "Space: The Forgotten Frontier." His starting point was the observation that planetariums have been losing popularity, but that's just the tip of the iceberg—just one symptom of a much more widespread fading of interest in, and support for, space exploration in particular and science in general.

Mr. Woodard asked my opinion about whether there was a corresponding drift of popular interest away from science fiction—*real* science fiction, in which the word "science" actually means something—toward fantasy. That one was easy. It's been clear for some time that fantasy, labeled as such, has acquired a very large share of the "science fiction and fantasy" market. Even much of what's now labeled "science fiction" has little interest in scientific rigor or plausi-

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bility. The kind that does—the kind *Analog* has always tried to provide—has come to be regarded in some circles as a rather odd minority faction, fenced off in its own little ghetto and posted with the warning sign "hard science fiction."

Then Mr. Woodard asked me, "Why do you suppose this is?"

And it suddenly occurred to me that this phenomenon just might be a case of Clarke's Law in action, not in the way one culture sees another, but right here within our own culture.* To many people who use it, *our own technology has become indistinguishable from magic!* As I've pointed out in at least one earlier essay here ("Magic," September 1993), we all use many everyday things, such as personal computers, television, and microwave ovens, that would have seemed like pure, unmitigated magic to most of our ancestors. Well, they seem like magic to many of us (present company excepted), too—because many, perhaps most, people use these things with little or no understanding of how they work.

The practical consequence? If too many people view existing technology as "magic," done by a sorcerer class fundamentally different and distant from themselves, too many of them may be content to use what they have and not motivated to learn how to further advance it.

There are at least two aspects to this blurring of popular perception of the distinction between science (and its applied offshoot, technology) and magic. First, I think there's a growing tendency to feel that we already have "magic" to do so many things that there's little need to concern ourselves with discovering or inventing more. Second, there's a tendency to feel that science is so incomprehensible that "there's no point in *my* trying to learn about it because it's too hard." Certainly there's always been a fair amount of that feeling around, but it does seem to be particularly potent now. (If you need more convincing of just how abysmally ignorant yet sneeringly disdainful many American adults are of real science, you might be interested in a recent essay on "Science and America" by Nobel Laureate J. Michael Bishop. You'll find it in *The Gettysburg Review,* Volume 8, Number 4, Autumn 1995; I thank

* Though C.P. Snow might say that those who do science and those who just use it *are* two different cultures!

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Michael Toman for calling it to my attention.) The blurring in the popular mind of the distinction between science and magic makes an obvious parallel to the blurring of the distinction between science fiction and fantasy. That parallel is not just an academic curiosity. There has long been a symbiosis, a mutual feedback, between science and science fiction. Science fiction has built on ideas from science—and in return has helped *create* new science by firing up the interest that led to scientific careers. Isaac Asimov, both a scientist and a science fiction writer, once estimated that half of all creative scientists were drawn into their fields at least partly by an early interest in science fiction.

Both science fiction and fantasy can be fun. What has made science fiction special is the idea that its subject matter is not only fantastic, but at least marginally *possible*. Few people read stories of dragons and elves and set themselves the career goal of *becoming* a dragon or an elf. But a great many people, in earlier decades of this century, read tales of space travel, computers, or medical advances, recognized them as real possibilities, and told themselves, "I'm going to help make it happen!"

And they did.

But to do so, they had to recognize a few other things, too. They had to recognize that turning such dreams into reality requires a solid understanding of definite physical laws. They had to recognize that gaining and applying that understanding takes *work*. And they had to recognize that, challenging though it is, such work is not beyond the capabilities of real people. Someone with enough smarts to see the possibility, and enough determination to learn what it takes, *can* help make it happen.

But how often will that occur if

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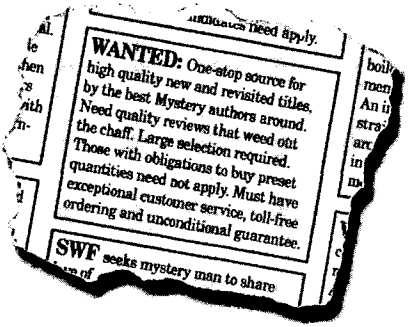
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more and more people become less and less able to grasp the distinction between science and magic, or between science fiction and fantasy? If everybody sees the technology already achieved as "magic," provided by Somebody Else to be used without understanding, who's going to create the next generation of it? (Or, for that matter, keep the old operational?) If readers fail to see science fiction as differing from fantasy in that it shows real possibilities that they themselves might help realize, how many will be inspired to do so?

It *may* be a false alarm—fads come and go in intellectual attitudes as in everything else—or it may be a real problem. If it *is* a real problem, what can be done about it?

A variety of things, none of them necessarily easy—but, as with science itself, that is not a reason not to try. Science teachers need to use whatever tricks they can to make real science and its potentials fire young imaginations not only with interest, but with the confidence that they, too, can aspire to making real contributions. Not, I emphasize, just tricks for the sake of razzle-dazzle. There's nothing wrong with razzle-dazzle—John W. Campbell was right when he said fervently, "Teaching ought to have more *circus* in it!"—but educational circus has to do more than entertain. It's fine if it can do that, but its real purpose is as a means to an end: to make students learn, and want to learn more. And teachers must never fool themselves into thinking that just because they've gone through the motions prescribed in the curriculum, they've done their job. The acid test is: Did it work? If not, they must try something else, and keep trying until they find an approach that does work.

And we in *this* field must discourage the growing illusion that great things will be done by hand waving. Some of us must still take the trouble to write science fiction with equal emphasis and attention to both words of the name—and to label our work carefully and honestly. How are people to see science fiction as something different from fantasy, something dealing with real possibilities just waiting for someone to do the work to make them real, if much bearing the label "science fiction" *isn't* that? How are people to understand that important complex of distinctions when something based on a vague faith in "The Force" is billed as the same kind of stuff as the visions of Clarke, Heinlein, or Asimov?

It has become fashionable in ever widening circles, *even among writers of science fiction and fantasy,* to pretend that there's no difference between them. It's true that some stories fall into a rather hazy "twilight zone" on the border, and a case can be made for calling them either science fiction or fantasy rather than clearly one or the other. But, as Kelvin Throop astutely observed, "Just because there's twilight doesn't mean you can't tell the difference between night and day." Encouraging people to pretend there's no difference does no one any favors, and just may have a real effect on how our culture develops—or fails to—in the future.

For starters, I'd like to see the

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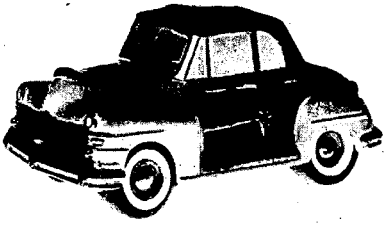

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phrase "hard science fiction" phased out—and replaced by a more careful distinction between the arts of science fiction and fantasy. "Hard science fiction" is too often too narrowly interpreted, and too often scares away readers who interpret the word "hard" in the sense of "difficult," even if writers intend it to mean "rigorous." All it really means, as I interpret it in my own fiction writing and in editing *Analog*, is this. Some scientific or technological speculation is so *integral* to the story that it can't be removed without making the whole story collapse; and whatever science the story uses is made as *plausible* as possible (whether by strict extrapolation of known science or by imagining new principles that might be discovered in the future).

Any science fiction in which the term "science" has any real meaning meets those criteria, and anything that doesn't is not *science* fiction, but something else. So we don't really *need* the term "hard science fiction"; it's just an unnecessarily severe synonym for *science* fiction.

But we do need a generally understood distinction between science fiction so defined, which by its nature offers real possibilities, worthy at least of real-world investigation, and fantasy, which may offer topnotch entertainment but makes no pretense of offering real possibilities. If we can just get that distinction across, our field may yet do its part to spread understanding of the fact that doing real science takes real work—but it's work that can be done, and it's the only way we have to make new kinds of "magic" real. ■

Every advance in civilization has been denounced as unnatural while it was recent.

—Bertrand Russell

To date, we've gotten closest to the human mind in the infant science of parapsychology, only recently let in the back doors of the halls of Establishment Science, when the Parapsychological Association was finally admitted into membership in 1969 in the American Association for the Advancement of Science (which is sort of a super AMA for Establishment scientists, designed to keep out the riffraff).

—P. E. Isaac Bonowits

Science is organized common sense where many a beautiful theory was killed by an ugly fact.

—Thomas Huxley

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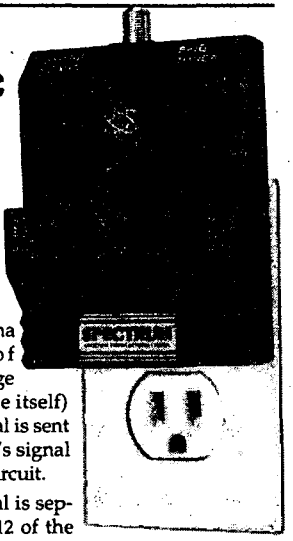
Fifteen years of microelectronic research makes conventional antennas a thing of the past!

This little box uses your home's electrical wiring to give non-subscribers, cable subscribers and satellite users better television reception!



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Spectrum system Precision tuning

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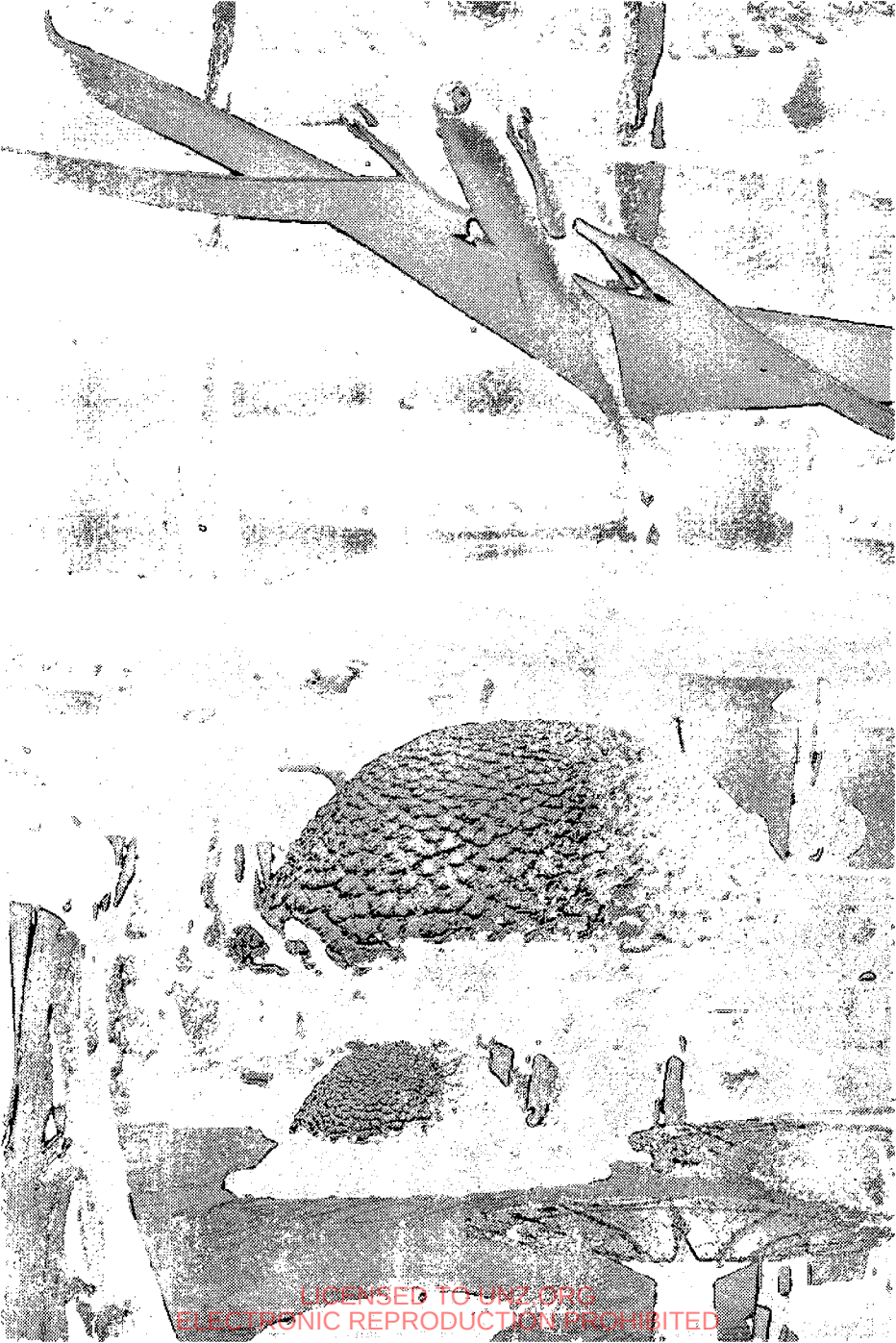

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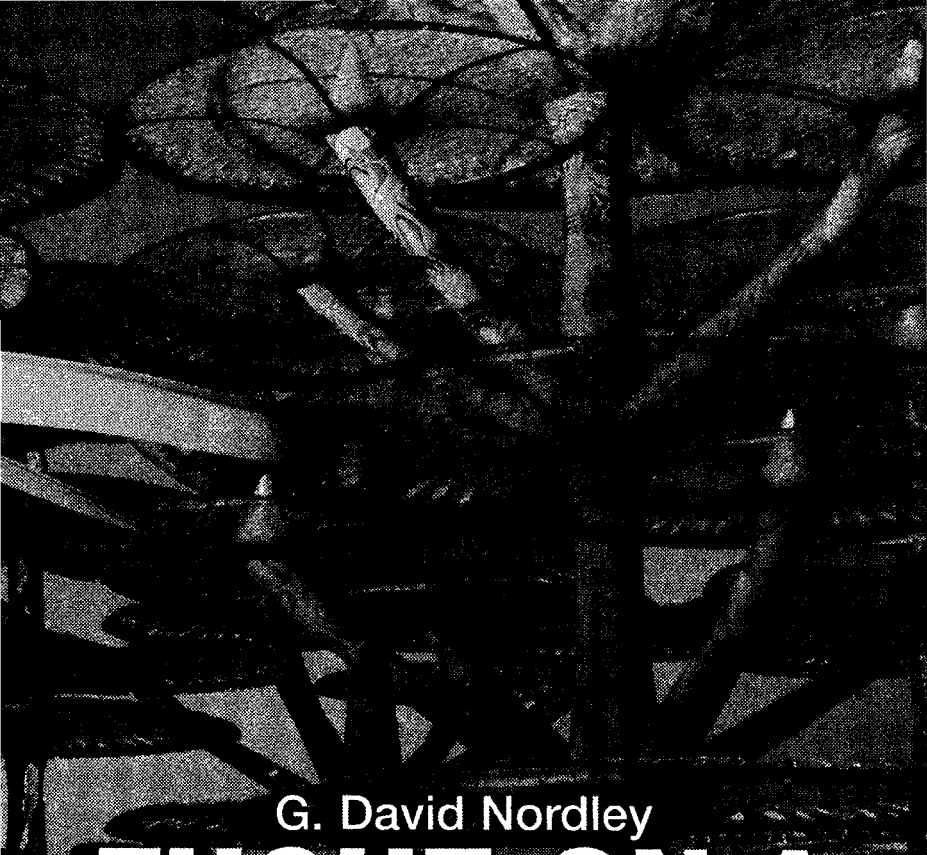

G. David Nordley

FUGUE ON A SUNKEN CONTINENT

a story of Epona

To deal with beings from another culture, you must understand how they think!

Illustration by Wolf Read

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"Disaster, Anna, is the way of life on Epona." Gregos Konstantis, Chief of Ground Service Operations, smiled ironically and looked past the beautiful but impatient woman on his office balcony across the Nell Strait and into the mainland. Disaster—and deception.

There, under the mist in the deceptively normal morning light of the star Taranis, lay Tir fo Thuinn—human names whimsically derived from Welsh, as Greg remembered, for the remnants of an ancient, slowly sinking continent. Its tropical lowlands glistened with a forest of triple-decked umbrella-leafed "pagoda trees" that were not really plants under what looked like a greenish gray-topped ridge. But the gray was dry-season forest, not stone, and the green was not forested foothills, but nearly vertical serpentine left bare as the last season's landslides ate a little more away from the old continent. Above it all was a sky crossed by occasional V-shaped flocks of beings that were not birds.

He turned back to Anna Wolf and shrugged. A classical vocalist, she had arrived with a cultural exchange mission thirty years ago, and as the Contact Mission's instant artistic establishment, had proved herself a *prima donna* in every meaning of the word. Beyond the reach of solar system birth boards, Anna had borne herself a child—who everyone assumed had been conceived by artificial insemination, given the mother's personality. Anna's disaster was that she was ready to take her daughter and leave Epona, but the daughter was nowhere to be found.

Kanti Wolf had inherited none of her mother's chauvinism and only a little of her temperament, but all of her perfect pitch and facility with the Uther language—which made her very important just now. Anna had to be put off.

Greg spread his hands in a gesture of helplessness. "You may need to make different plans."

"Your favorite line!" She was used to the favors of men and had run afoul of Greg's indifference to her charms before. "Plans!" She waved her hands dramatically and strode into his office. "Did you turn your cyberservant off?"

At least she showed that much discretion. What a cybernetic intelligence didn't know, couldn't be hacked out of it—and the native Uthers's sophistication in electronics was increasing exponentially. He followed her meekly inside. "Yes, Anna."

"Well, I hear that—" she sang four notes, "—is going to demand that we give him the inner system starbase and may hold some of us on Epona hostage to get it."

The notes, Greg thought, *were likely D♭, C, E and G, the tonal symbol of the airlord of the local metaflock.* "D-flat Seege" was what most humans on Epona would have said.

"I want us in a starship," Anna continued, "riding a mass beam out of this star system while we still control it!"

"You've been here long enough, Anna, not to worry too much about the plans of an Uther. Such plans have a half life of about three weeks." That

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was only partly true; while most Uthers were characteristically volatile, Uther leadership could and did plan for the long term.

She ran long, delicate fingers through her straight jet-black hair and sighed in dramatic exasperation. "Then why are we building another starbase way out at Borvo?"

Greg frowned. Borvo was the Taranis system's equivalent of Jupiter, and the new starbase in its Trojan asteroid cluster was supposed to be kept very quiet. Even quieter were Knute's plans to totally dismantle the inner system base before the Uthers demanded it be given to them

"Anna, the Uthers are expanding, colonizing the inner worlds of their planetary system. The long-term plan is to lessen our impact on this evolution by quietly moving human interstellar traffic out to the outer part of this solar system."

"Nuts. I'll tell you why!" Anna didn't quite shout, which would have been an ear splitting weapon at this range, but put just enough volume into her exclamation to threaten what might be, if she got really disturbed. "We're building one at Borvo equilateral because Coordinator Larsen is going to sit by like an overly permissive parent and let them have the inner system starbase!"

Close, Anna, Greg thought. "Anna, *please* avoid saying anything aloud, even in English, that *hints* that we are the Uthers's parents. Don't even think it!" He paused a moment, for effect. "Now, the Coordinator has no intention of giving the inner system starbase to an aggressor flock like the Fay D-flat Seege. They don't speak for all the flocks of Epona."

"You fill me with confidence. When, if ever, will our dear Knute *act* on such noble lack of intent?"

He smiled. Next to Knute Larsen's plodding deliberateness, the spontaneous Uther seemed almost human. Even so, the other thousand or so humans in the system relied on the Coordinator's constancy and carefulness—it let *them* take the little chances that led to progress and understanding. He turned back to Anna and lied. "Look, we are all boringly safe. At worst, we might be inconvenienced. Now, do you have any idea of where Kanti might have gone?"

"Don't you? Who's Kanti been flying with, besides you? Don't think I haven't seen you strapping on wings and flying with her. I'm worried. She isn't careful enough and it's going to end badly for her. Like Icarus or something—you know the story; you were born in Greece, somewhere."

"Khania," he told her for the fourth or fifth time. What would she make of her Icarus analogy when, and if, she realized that Khania was on Crete itself? "Flying isn't dangerous if you know what you're doing, and it lowers many Uther-human barriers. They can't help but consider ground bound beings as their inferiors, but flying—"

"Khania's near Athens, isn't it? I've sung in Athens, and in Greek, too!"

God save the Hellenic Republic, Greg thought. "Another time, Anna. Kanti flies with an Uther friend, a Geecee, about her own age—just coming into maturity. The family often perches in the red cliff hollows

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over Fingal's Cave."

"They're still under the so-called protection of that duplicitous. . . :" she sang four different notes.

Likely F, E, D♭, and G, Greg thought. Roostlord Feedyflat-gee had sheltered the human mission for a dozen Eponan years—the longest residence in the century-plus since people had come to study the Taranis System. Eventually loyalties shifted, and the humans were sold to the Fay Seeffay, who had loaned them their present quarters. Anna's emotion toward Feedyflat-gee was unwarranted, he felt—a projection of human moral ideas on the Uther. Uther philosophy was to "fly with the flock the storm winds give to you." How Anna could be so fluent in the Uther language and so dense about other Eponia was an unending source of amazement to Greg.

"It's where she grew up, Anna—it's where her young Uther friends are."

"But we're the *enemy* now, part of the—" she sang F, A, C, F, F, A, which Greg mentally translated to Fay Seeffay "—metaflock. I just don't understand how Kanti could fly away alone now, like some Uther on a fugue! I'll bet they've kidnapped her just to keep me from going. She's in deadly danger!"

"The situation's a lot more complicated than that, Anna. These are intelligent beings, and there are lots of cross-flock ties." Uthers were the ultimate team players, but they were capable of changing teams with bewildering quickness. In theory, friends, and even seasonal lovers, can become deadly enemies overnight at the flip of an airlord's wing, and in primitive areas, neonates of newly alienated partners were still destroyed when flocks parted. "Locally, roostlords, harvestleads, and elders still have influence. I doubt that she's in any real danger."

Anna's eyes blazed at him. "Doubt isn't good enough. We are booked out on the *Vulpetti* next week and have a place on tomorrow's shuttle. As the local servop, your job is to help me find her so we don't delay the starship!"

She had him there. Unlike most humans here, he was not a researcher—at least not officially. That would have put his subjects on guard, and since human Ph.D's tend to resent anything that smelled of surveillance every bit as much as Uthers, he kept his activities very quiet. But to maintain this cover, he had to provide the services his title promised.

"Very well, Anna. I'll go find her and talk to her."

"I want that on record."

Now, Greg thought, *we really roll the die.* "Reactivate 45832. Penelope?"

A section of milky white chitinous wall suddenly appeared to become transparent, revealing a nook decorated in a classical Greek mode, with a vase, a rack of scrolls, a simple but elegant painted table and a chair fit more for a queen than a receptionist. A classical beauty with auburn hair piled high and held by jeweled combs, walked into this frame wearing an authentic-looking Mycenaean era gown and sat down at a brightly painted wooden desk. "Yes, master?" a prim female voice answered.

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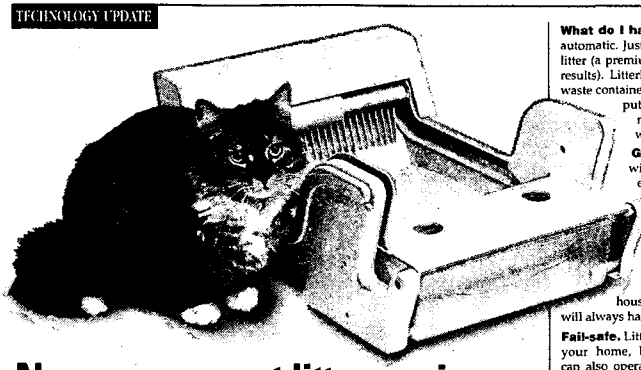

Never scoop cat litter again... Computer technology creates the only self-cleaning litter box!

You and your cat will love the way LitterMaid eliminates the hassle, mess and odor of the ordinary litter box.

by Shirley Liberles

Computer technology revolutionizes the litter box...

LitterMaid, a patented product from Waters Research Company, is a completely self-cleaning litter box operated by a microprocessor, but your cat uses it just like a normal litter box. Approximately 10 minutes after LitterMaid's "electric eye" senses that your cat has exited the litter box, it signals the start-up of the automatic sifting comb. ★ The comb sifts through the litter, scooping up any waste. ★★ The waste is deposited into a sealed, air-tight waste container and the comb returns to its original position, smoothing the litter. The system resets, ready to repeat its cycle the next time your cat uses the litter box. ★★★ When the waste container is full, you can either throw it away and put a new one in its place or empty it and reuse it for up to one year!

House cats. Large or small, affectionate or independent, young or old, long-haired or short, they all create the same dilemma for their owners—the litter box.

There are few things I can think of that are as foul as cleaning the litter box at my house. Even when I clean it daily, it's difficult to keep odor away. And this problem is multiplied because I have two cats! But because I love them, and that's virtually all the maintenance they require, I do it...because there's no other option.

Well, today there's a solution that cat owners across the country will be thrilled about. LitterMaid, manufactured by Waters Research, is destined to make ordinary litter boxes obsolete!

Automatic cleaning. LitterMaid is a computerized, completely self-cleaning litter box. Its operation is controlled by a microprocessor. An electric eye senses when the cat has exited the litter box, and minutes later, it signals the start-up of the automatic sifting comb. The comb sifts through the litter, scoops up any waste, and deposits it into a sealed, air-tight disposable waste container. The comb then returns to its original position, smoothing the litter. LitterMaid is now ready to begin another cycle as soon as necessary.

Revolutionary. LitterMaid may permanently change the face of the cat-product industry. Cat owners will never again have to endure the unsanitary and odor-filled chore of cleaning their cat's litter box. Plus, there will be no more embarrassing litter-box odor in your home, because the disposable waste container is sealed and totally air-tight!

What do I have to do? LitterMaid is fully automatic. Just fill the pan with *clumping* cat litter (a premium brand will provide the best results). LitterMaid does the rest! When the waste container is full, just throw it away and put a new one in its place. You'll never have unsanitary contact with cat waste again!

Good for your cat. Not only will LitterMaid make *your* life easier, it will make the litter box a nicer place for your cat. Most cats dislike using litter boxes that are dirty, and that can lead to them not going to the bathroom. Or worse, they may choose to use the bathroom around the house! With LitterMaid, your cat will always have a healthy, clean litter box.

Fail-safe. LitterMaid plugs into any outlet in your home, but it can also operate on eight "D" batteries. So even in the event of a power failure, LitterMaid will continue cleaning. It is equipped with an alarm that alerts you when the batteries are running low.

LitterMaid eliminates...

- *Embarrassing litter-box odors*
- *Having to endure the unsanitary and odor-filled chore of cleaning your cat's litter box*
- *Limiting the areas within your home in which you can place the litter box*
- *Worrying about how to clean the litter box if you go on vacation*
- *Having a cat who refuses to use the litter box because it's dirty*
- *Some risk of catching a disease from the cat's waste—this is especially important for pregnant women and people with immune deficiencies*

Put it anywhere. LitterMaid is only a couple inches longer and taller than conventional cat litter boxes. It should fit easily where your litter box is now—and you should put it there at first, until your cat gets used to it. But later, because LitterMaid is odorless and sanitary, you have the opportunity to place it virtually anywhere in your home—without any ordinary litter-box worries!

Try it risk-free. LitterMaid is backed by our exclusive risk-free home trial. Try it, and if you're not completely satisfied, return it within 90 days for a full refund, "No Questions Asked." It's also backed by a one-year manufacturer's limited warranty.

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"I'll be out this afternoon, at the Geecee roost on the mainland, looking for Kanti Wolf at the request of her mother. Mind the office."

"Of course. Your wings are ready on the balcony, sir."

Anna took one look at "Penelope," gave Greg a tight-lipped smile that was not exactly one of approval, and headed out of the office for the balcony and the elevator. "I don't think I'm going to keep your hologram company. Call me when and if you locate Kanti, Mr. Konstantis," she said. "My final performance on Tir fo Thuinn is tonight, and I would like to give it with some peace of mind."

Greg smiled. "No doubt. Penelope, Ms. Wolf will need a lift up to the heliport."

"The elevator is waiting. Have a good journey, ma'am." The humans had been permitted to place elevators outside their floor that took them up through the two balconies remaining between their level and the roof. Otherwise, the only way out of these old towers was to fly from a balcony.

"Good-bye, Anna," Greg said to the closing elevator door.

When Anna was gone, the woman at the desk sprang up and pulled off her wig to reveal a short utilitarian mop of jet black. She set it on the desk, walked around the now-transparent divider into the office proper and laughed. "Whew! She never suspected!"

Greg shook his head with a bemused grin. "Not for a moment, Kanti. People see what they expect to see." He felt a twinge of guilt at the charade, but a cybernetic "servant" could not participate in the deliberate deception of Anna Wolf, and she was the last human on Epona who could be told anything confidential. Fortunately, the computer "off" switch was an inviolable human right, as much as any were truly inviolable, and Anna would now spread the cover story as if it were the truth.

"Is Bach waiting?" Another smile—the Uther's name was the first example of a human-Uther pun that Greg could think of; its parent had chosen the name to recall the composer.

"It's B A C G♯'s idea." Kanti sang the H at the end of the Eponan's name as G♯—the old German would have used "H" for B-natural, and B-flat for B, but nowadays "B" as B was too ingrained. So, in their effort to transliterate Uther names, Epona's humans assigned H to the note between G and A.

"Let's go!" Kanti said. She dashed for the balcony, all queenly reserve vanished.

"Wait!" Greg almost shouted.

She spun around and looked confused.

"First, that Penelope get-up isn't for flying through the jungle. Second, your mother is still on the heliport. So just hold it a minute, OK?" Greg opened the panel covering the field equipment shelves, handed Kanti her bag and took out his own equipment.

"Yeah, thanks." She peeled a couple of cheek patches from her face and wiped off her make up, revealing a thinner, tan face that spoke of many hours in the air.

The girl was impulsive, even by Uther standards. But for now, she was

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the key to Bach and Bach was the key to understanding what the Uther were planning. "Nose around the Uther," Knute had told him. "Something more than the usual demands seems to be going down."

Easier said than done—but a Fay Feedyflat-gee recruiter had been to Fingal's cave. Bach was at the age when adolescent Uthers left their nesting grounds "on fugue" for such adventures. But Bach had told his human friend, who had told her flying instructor, who happened to be Greg.

He hadn't known Kanti that well, but the opportunity had been too good to pass up. Would she mind taking some risks? Would Bach cooperate? She'd jumped at the chance to do something exciting—if anything, she'd been too eager.

She was aesthetically beautiful, but Greg had long ago decided that his reproductive drive was a nuisance and opted for some minor genetic retroengineering. Kanti's occasional attempts to flirt were amusing, but, unlike Anna's heavy-handed come-ons, not an irritation. Still, he told himself, he should have a talk with her before feelings got hurt. But the last few days had been very busy.

A whir of helicopter wings came on the hour, which told Greg the copter was human and AI-controlled. Human copters whirred—they used superconducting electric motors powered by nanomolecular spin batteries, while the Uther copters screeched; they used rotor tip jets—peroxide-hydrocarbon versions of the ancient Hero steam engine. Lower gravity and plentiful hydrogen peroxide content allowed them to do things that had taken humanity much longer.

"OK, her helicopter's here. Get your wings on while I leave a message for Knute."

Security was paramount. Spying on people was bad enough, but spying on Uther could get them kicked off the planet. They were guests here, not gods. Greg wrote his note longhand, took a digital picture of it, then put the bits through a scramble routine that pseudo-randomized them and hid them as sidebands in an audio recording. The recordings were of Uthers singing Bach—somewhat off pitch by human standards because of how the Uthers' vocal apparatus worked, but still quite recognizable. Greg stored the doctored audio on a data wand and stuck it in a reader.

Kanti changed while he did this and the next time he looked at her, she'd donned a loose green jumpsuit with an airy weave of near-indestructible fibers.

Greg grabbed a three-day kit from the shelf for himself and tossed one to her.

She snatched the half-meter long sausage-shaped bag in midair and wrapped it around her waist.

Greg did likewise. His tropical office shirt and dark trousers were actually a fully field-capable one-piece coverall—being ready to go quickly was part of his job. He exchanged his sandals for field boots, activating the tongue seal just as they heard the helicopter depart.

"She's off. You'll need to leave first, then I'll turn the real Penelope on again, send the recording to

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Knute, and follow you."

"Got it. See you at Fingal's cave." Kanti gave Greg a quick peck on the cheek and scampered out on the balcony to strap on her gear.

With Greg watching for mistakes, still the instructor, she opened the wing closet—a tall compartment on the balcony between the elevator tube and the outer office wall. Her folded wings were two meters long, half a meter wide, and formed a package about two centimeters thick. Deployed, they would measure almost nine meters, tip to tip. They weighed less than two kilograms and shimmered like dragonfly wings in the noon sun. She plugged their stubby cylindrical roots into the back unit, in five-centimeter holes a half meter below her shoulders. As soon as she did so, they rotated to a vertical folded position. Then she climbed onto the balcony rail.

Greg thought she looked like Tinkerbell in camouflage gear. He waved to her, and she waved back. Then she reached up and laid her arms against the insides of the wings' cupped leading edges. Straps that were almost transparent curled out and around her wrists and elbows in response. The tail surfaces snapped out from the cylinders on the sides of her boots like Japanese fans.

She pulled the wings down slowly, and they unfolded from one-way hinges to their full nine-meter span. She raised and lowered them twice, as if doing a strange form of tai chi, testing them, becoming one with them again. Then she bent her legs, arched her back, and leapt from the balcony, snapping the wings down with enough force that she actually gained a little altitude before gliding into the windward updraft.

Good flight, Kanti, Greg thought, *conserve your energy.*

He looked around the office, saw Kanti's discarded "Penelope" outfit on the floor and stuffed it in the recycler. He restored the partition of his private nook to its normally slick chitinous appearance, took one last look around for anything that would reveal that Kanti had been there, and said "Reactivate 43895," to his wrist comp.

"Back again," Penelope announced, "after an hour! What did Anna want to talk about?"

"Her daughter, Kanti, flew off, and Anna thinks it has something to do with some Eponan politics that you shouldn't be burdened with. I'm going off to find the young lady and persuade her to come back and talk to her mother. In the meantime, why don't you see what the chances are of scheduling another starbase shuttle in time to catch the *Vulpetti*?"

"Eponan or Human?"

Greg allowed himself a grim smile at the thought of Anna on an Eponan shuttle.

"Either. I'll assume Anna will go on the human one and wait for her daughter at the starbase." He pulled his own kit out of its locker, and gulped. Kanti had left the locker door open—but anyone seeing that when Penelope's record resumed would think that he'd opened it to get his own gear. "I'd better get going."

"There's a tropical storm approach-

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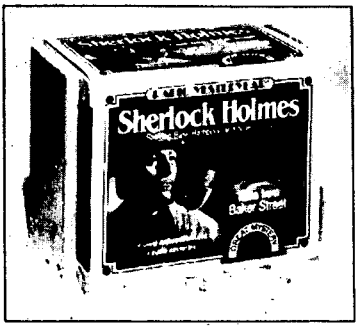

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ing from the west."

Greg grimaced. The weather. When everything else on Epona was going right, there was always the weather. The low sunken continent was no barrier at all to late season hurricanes. "How soon?"

"Three hours."

"I'm just going to Fingal's cave on the mainland. It should take sixty minutes max—might even make it back with Kanti." If all went right, he might not be back for days, but play the role, yes. "Oh, and send Knute what the Fay Feedyflat-gee did with Bach's Fugue in G. It's in the rack."

"Message sent. Good luck, Greg." The office wall turned into a real hologram this time, and the classical Greek beauty in it waved farewell. She did look somewhat like a more rounded, softer Kanti, he thought, except the face. That came from a memory burnt too deep to forget—so he had decided, at least, to remember it accurately.

Three hours? By the time he had his own wings and boot-fans on, it was already so gusty that he simply rotated his wings to a positive angle of attack, and rode the draft up like a blown leaf. The computer in his back unit adjusted all the angles and twists of his wings for maximum efficiency as his hands and body language supplied the basic sense of direction.

He sheared off to the right over the city until he found a back eddy that took him out over the strait between the island of Fay Seeffay's metaflock and the Fay Geecee part of the mainland. The storm circulation brought the freshening winds in from the southwest, more or less along the strait.

Trading altitude for distance, he glided for the nearest shore, crabbing to his left across the moving air mass until he was over the shallows of the mainland. The low plateau to his right was all that was left of a mountain range piled up in the last throes of continental drift on ancient Epona. A few hills still approached a thousand meters in altitude, but most of it was worn down to two or three hundred. Still, that was huge on a human scale, and its storm and current-undercut cliffs had enough of a wind shadow beneath its turbulent edge for Greg to make progress south under the wind.

Warm air from over the vast continental sea drifted into the sunken continent here and rose in occasional updrafts against chalk and sandstone cliffs to meet the west storm wind in a layer of turbulence. Greg used the updrafts to gain altitude until it became rough, then glided southward below the cliffs, aided by occasional sweeping strokes of his wings. He descended until he skimmed the shore like a gull, then rose on the next updraft. He felt exhilarated, not only by the sensation of flight, but from the sense of expectation that this particular flight brought.

Storm reports were still ominous, but it was moving slower than expected. Greg thought he easily had another hour or two before the weakening depression crossed the continental mass. Not only that, but he seemed to have picked up a tail wind.

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A tail wind? But the storm was blowing in from the west. Greg triggered his comset. "Met Local, I've got winds from 0-3-0. What gives?"

"Roger, Konstantis, be advised that the storm we've been watching has started tracking south, and an anticyclonic instability has been drawn down from the northeast. It's a minor cold front, not regionally significant, but it could be nasty locally. You might want to put down and let it blow over."

"Roger, Met Local, copy." Greg had no intention of putting down as long as the new storm was blowing him where he wanted to go. He'd put down when he got to Fingal's cave and let it blow over there—while he got up to speed with Kanti and her Uther friend Bach.

Getting an Uther to make a covert appointment was a minor miracle in itself, and for the Uther to be there and the Human not would be an ironic disaster. Greg invested some more of his own energy, driving himself south. Minutes went by in the fog of steady effort.

Out of boredom, he glanced behind himself and saw the cold front. Minor? Its cumulonimbus stretched way up; even allowing for a 25 percent increase in vertical scale due to Epona's 25 percent lower gravity, that was an awesome pile of clouds, coal black on their undersides. Ten kilometers away? No, the clouds seemed to roil up out of thin air, forming a front that was much closer than that.

Greg looked down. Rocks and bubbleweed marsh reached in right up to the edge of the cliffs. He looked up. The plateau seemed devoid of any usable shelter, but he knew it was full of gullies with occasional caves and littered with enough dormant "vegetation" to thatch a crude roof.

He glided closer to the cliff where air pressing upward from the surface should form an updraft. He found one and soared up over the edge—and then it really hit him. Before he knew what was happening, his wrist comp told him he was a kilometer above the plateau. Big mistake—the oncoming front had sucked him in.

Clouds sprang up all around him and it was numbingly cold. A brief hole below him revealed clouds scudding by at an incredible rate—his heads up display showed a ground speed of forty meters a second—westward. He was already twenty kilometers inland.

To get back, he would have to land and wait for the normal seasonal winds to assert themselves, then ride them back to the coast. Of course that would make a mess of his schedule—and since he was doing everything secretly, there was no way he could simply call Kanti and tell her he would be late.

Or could he? "Voice mail."

"Voice mail ready to receive from Greg Konstantis. Who is the message for?"

"Anna Wolf, with a copy to Kanti Wolf and Knute."

"Proceed."

"I've been blown off course and will be several hours longer in finding Kanti than I planned to be. Kanti, if you check in, please call your mother and be patient. We need to talk.

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Knute, the Bach I promised you should be in the mail. Konstantis out." These same words would mean something different to everyone who heard them—he allowed himself a momentary grin at his own cleverness.

He tried to lose altitude, but the updraft got more fierce as he dropped lower until, stooping like a hawk with his wings straight up, he could get no lower. "With the flock the storm winds bring, you fly," the Uther saying went. He faced the mists, held his altitude and waited.

Thirty kilometers from the coast, another opening below him revealed the tops of the low hills that formed the divide of the slowly sinking continent. The windward side had no real dry season. There, ancient river valleys widened by periodic glaciers had carved countless lush, flat valleys.

He started to lose altitude now. He linked with Met Central and studied the map. He'd been aloft almost two hours and ached everywhere, but the front was weakening, and a few kilometers south was an L-shaped valley he thought he recognized. A recently-declared "harvesting reserve for the Fay-D-flat Seege." What that normally meant was an area protected from other scavengers. Airborne hunters would spear a ceretridon, then fly in for the feast. Ancient competition with the Uthers' ancestors and relatives left ground scavengers few and slow, so the kill would be safe until it ripened to Uther tastes. There were thousands of these reserves across the sunken continent.

Human distaste for such activities was well known, so if an Uther airlord was up to something he didn't want a human to know about, Greg reasoned, a harvesting reserve was as good a place to hide it as any. The satellite view would simply show a pagoda tree forest, and robot surveillance flyers had to be used very sparingly for fear of malfunction and accidental technology transfer. Greg now had, he thought, as good an excuse to be in such an area as any human would ever have. When fate gives you a lemon, make lemonade. A yellow and green tethered balloon floated over the area—a hunting perch—or a guard station. He banked left and headed south.

Almost immediately, there were Uther in the air over the area, looking from a distance like giant tailless dragonflies. The forewings, though, were shorter in proportion and beat the air in a kind of undulating motion rather than stiffly. They had great vision; if he had been able to see them, he could be sure that they had seen him.

He banked and glided at right angles to the line between them, making it hard for them to judge his distance by parallax. His slow, deliberate course was, he hoped, nothing they would consider evasive or hostile. Time to call home, he thought. "Voice mail, for Knute."

After a moment, his wing set computer responded in dry, standard tones. "The link wasn't achieved due to the electromagnetic noise environment."

This gear would punch through storm interference easily, and already had. He was being jammed. Quick students, these Uthers. Knute, Greg real-

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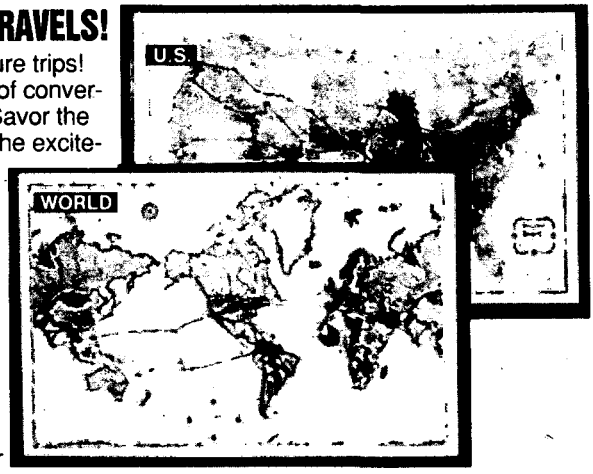

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ized, was way behind the power curve on this one. Would some surveillance robot recognize the jamming as different from storm lightning? It probably could if it were looking for that, but looking for that would be the kind of purposefully creative act that, even now, artificial intelligence didn't do very well.

The Uther guards, if that's what they were, probably did that kind of thing very well, and would have immediately recognized his transmissions as artificial. Sure enough, they'd all banked toward him, in unison, like a flock of crows. He was far too tired, and the power level in his wing pack was far too low to try to run for it. He would learn as much as he could, and try to talk his way out of it.

He heard a faint tone, like the ones used to test hearing—it was his computer's rendition of the Uthers' sonar—like bats, they could range and image, roughly, with sound waves. They would expect him to react now, having announced their presence.

He began by assuming a long, flat glide toward the Uther and selecting his translator. Remembering the object-subject-verb version of simplified Uther-human translation grammar, he composed his greeting, then shouted, "I the storm blows-here. Tired I am. Help I must buy." There was no mote in Uther for "give" or "receive without compensation."

Beneath where the Uther had been flying was a large, roughly rectangular area of the preserve that looked different, somehow. It took him a moment to place why. Then he realized that all the pagoda trees in it, though randomly placed, were the same height, causing the fractal-like dimpling of most of the forest to abruptly change into a kind of regular shading.

As he got closer, the Uther answer arrived—triad chords coming out milliseconds later as, "No closer you come. To ground-under you descend." Ground-under meant "under the pagoda tree canopy," as opposed to resting simply on anything attached to the ground, but Greg decided to misunderstand somewhat. The tree would be more comfortable.

Taranis poked out under the storm sky, painting the forest below gold. The sunlight glinted off the spearheads carried by the Uther as they flew in a slanted line toward him. He spotted a largish pagoda tree in the area below and banked toward it, losing altitude and turning away from the anomalous area, but continued in a spiral that brought it in view again.

From this lower angle he could see the trees were like nothing he'd ever seen on Epona—beneath their umbrella shaped canopies they were huge fat wedges, almost like Uther rocket shuttles, though twice the size of the usual. Nonsense, he thought. The area was about, what, fifteen trees wide, and over four times as long? There would have to be a thousand of the things.

He flared a few meters above the treetops and looked for his target, headed directly towards it and picked up a little speed. Then with a quick turn up, and a wing beat *down* with the last of his strength and power, he popped up over the broad drooping-ring leaf and stalled, dropping softly

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onto its trampoline-like skin. He lay there, wings askew, too tired to lift his pain-deadened arms. He had been aloft two and a half hours. Marathon fliers could do about four, but they trained for it.

Exhausted as he was, he couldn't help but be impressed by the incredible beauty of the burgeoning sunset and the lush Eponan forest. There was a curious kind of exhilaration in his limb-deadened numbness, and a luxury of warmness after being so cold. Alien scents that reminded him somewhat of ginger and warm chocolate tickled his nose.

An entirely incongruous place to hide an armada of a thousand spacecraft. But that's what they had to be, he realized. It all made sense now. D-flat Seege had an ace up his sleeve—one that leapfrogged human intelligence estimates. Their plan was not to demand the starbase—they meant to physically seize it with surprise and overwhelming numbers. The rockets were mixed in with some real pagoda trees, and the canopies were probably made of real pagoda tree canopy material. For that matter, the rocket hulls were probably composite organic and silica—there wouldn't be enough metal in them to interest a sensor. From orbit, or the air, they'd be taken for odd pagoda trees—hell, he'd been almost on top of them and taken them for that.

They would be easy to blow out of the sky with any kind of advanced weapon, but the human contact mission had studiously avoided making weapons. The starbase mass beam itself would be a terrific weapon, but its real-time steering capability was in microradians—to turn it around would require turning the whole asteroid to which it was anchored. No, the base couldn't be defended in a surprise attack—at best, the human crew might do some minor damage and escape; but if Knute got sufficient warning, it would be a different story. Replicators could make things quickly.

I, he thought, *have company coming. Best get ready for it.* With a tremendous, muscle-torturing effort, he sat up. He could not raise his wings above his head to fold them with his arms, but the pack had enough power left to do it for him. His arms dropped like leaden weights as the straps released.

Then the Uther arrived. There were three, one with a half-grown neonate attached behind its head. The neonate's eyes, Greg remembered, could detect movement above and behind and warn its parent—which made Uthers with a baby on board prized military recruits. Different circumstances, different values. Greg tried to imagine an army of pregnant human women.

The other two were, at first sight, indistinguishable. But, knowing what to look for, Greg found four light streaks on the cephalothoracic barrel of the one on the left, while the one to the right of the pregnant adult was even-colored.

The one with the neonate sang. "What providence (buzz) gives to (buzz) Uther, our eyes see and teeth suck in. (Buzz) Enemy flock may belong to," Greg's translator provided in a time-driven compromise between

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the original Eponan mote order and normal conversation. The vaguely poetic result, Greg knew, made the Uthers sound more benign than they were.

And this didn't sound very benign.

"To you," Greg replied, though he wasn't sure he'd been spoken to, "this human offers greetings." He'd learned long ago that the translators made fewest mistakes when he expressed himself in some approximation of Uther mote sequence, and prided himself on his ability to do this. "For stillness I am sorry, but great discomfort now any movement would make."

"Spy trick (buzz) Greg Konstantis would (buzz) maybe. (Buzz) We (buzz) Uther laugh," the four-streaked Uther hooted. "Laughter." Somehow, they already knew his name—of course, Knute probably had search parties out looking for him in response to his voice mail message. Their conversation was not meant for Greg and his translator was having problems, but the last notes of the triad corresponding to the second buzz sounded a bit like D-flat C E G.

Then they addressed him directly. "To the Human flock we say 'Back over the High-hills Greg Konstantis maybe fell.' Laughter. To the ground-under, you must go now."

About thirty meters, Greg reckoned. Experimentally he tried to lift his arms. No good. He checked the power level—actually it wasn't that bad, maybe 2 percent left. He activated the emergency descent mode, then simply scooted toward the edge of the huge umbrella-like leaf until friction no longer held him, and slid off.

The wings deployed to 80 percent automatically, assuming a configuration that would look like a flattened M from the front, with him at the lower middle point of the M. This slowed his fall like an air brake. At three meters altitude, they beat down the rest of the way, and the thrust broke his fall to the point that his feet hit not much harder than if he had jumped off a chair.

His leg muscles were not that tired and, surprising himself, he was able to stand. The forest floor was already in twilight and squishy with roundleaf underfoot. All kinds of grunts, whistles, and clicks greeted his arrival.

A small springcroc sprang up from almost under his foot and snapped its shell-like jaw at him in midair. It missed. Then it performed some kind of acrobatic maneuver to land balanced on its single leg, staring at him with the beady crocodile eyes set on top of its jaw. For a moment Greg thought it would spring again, but, instead, it sank down into the roundleaf as he watched, its busy foot drilling a hole for it in the soft muck.

A bright beam of light cut down from above and cast a pool of light beside him. A brief cacophony of off-key notes followed it. "That way Greg Konstantis must go," said the translator.

He picked his way through the vegetation toward the pool of light, and it moved away.

Notes. "This light Greg Konstantis must follow."

He followed for twenty minutes until he saw a single pentagonal tower,

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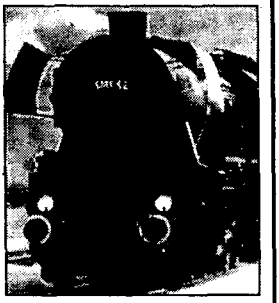

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about five Uther stories tall, with a rounded roof that would look like another pagoda tree from above. From below, it looked vaguely like a giant mushroom. He walked toward it.

About halfway there, a door—really a section of wall on a pivot—swung open and a human female walked out to greet him.

"Hi," Kanti said, her voice full of disappointment. "Bach kidnapped me at our rendezvous."

Before he could answer, the three Uther landed. Two assumed relaxed poses but the one with the neonate flowed to a tripod posture on his rear wing fingers—it was a sign of dominance.

Kanti sighed and waved a hand at the Uther with four light streaks. "Greg, meet Bach."

The Uther hooted, then broke into a passable rendition of "Jesu, Joy of Man's Desiring," then hooted again. Greg understood. Another typically Utherian disaster had struck his mission—Bach had gone over to the Fay D-flat Seege and was laughing at how he'd tricked them.

"Bach, hello. Kanti's friend you are still?"

The Uther hooted and sang, and the translator followed, "Laughter. Such a thing Kanti still thinks—so Kanti I captured easily. Slow thinking, humans are still. Flockmate one is or is not. (Buzz) a friend is. With that word, I jest." It hooted again. "Laughter." Utherensis had been named by a Dane who pronounced it "ooter" for the sound they made when amused.

But Greg was not amused. He tried hard to think. "Good things, D-flat Seege may destroy. Unprofitable in the far, far time this flock may be."

A warble from the Uther with the neonate, then, "Star travel, Fay D-flat Seege want, and star travel humans will not trade. But the starbase humans defend too lightly. So, the starbase D-flat Seege will spear—will eat. Then star travel and great power the metaflock Fay D-flat Seege will have." It hooted. "To themselves weak humans help do this. To all providence gives."

Bach warbled and added. "The stars I gain quickest this way. Highest of Fay D-flat Seege this Uther will fly and Fay Bach this flock may become someday."

Greg shook his head. "Your old Flock, Bach must remember. They, the Fay D-flat Seege may kill—if the starbase technology the Fay D-flat Seege takes. If humans, Fay D-flat Seege tries to fight, many Fay D-flat Seege we may have to kill. What profit such a big killing makes?"

The translator's discords faded and Bach warbled in return, but fell silent when the Uther with neonate overwarbled. "Unnecessary, a big killing may be," the translator said, "if the Uther lifestyle you respect. Big enough for both, the Universe may be. Boundaries, small killings will keep and good fun, small killings are. To the Fay D-flat Seege, you humans now belong. D-flat Seege, you will flight-follow when, from this star other humans have fled." It hooted then sang, "Earth itself, by grace of the Fay D-flat Seege wings, you could someday manage."

Greg shook his head. His fellow hu-

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mans typically abhorred any war and either had peace or fought only as big a war as necessary to defeat an aggressor. But he refrained from saying that, feeling that *that* discussion belonged at least at Knute's level.

"In mind—and body—I am tired."

The Uthers all hooted, having won what they probably thought of as a verbal victory.

"Then sleep," the Uther with the neonate, "you humans shall have. But your wings we shall have in trade—and all of what may be weapons or escape aids, we shall have too."

The Uthers eventually took everything but their clothes and food only the humans could eat. And that, they had to carry to their ground floor quarters in their hands. The lower wall was solid rock, and the cleverly counterbalanced section of pivoting wall was at least a meter thick. It could be locked behind them by simply disconnecting the counterweight, which Bach demonstrated with a hoot. It then motioned them into a bare gravel-floored room that opened into a sandy courtyard.

Without translators, there was no further conversation, and the Uther swung the door shut. It settled with a very solid thump as the counterweight was detached.

"Welcome to prison." Kanti pointed to the opposite side of the courtyard, visible through the arched interior door. "I've defined that as the latrine," she said. Their feces, Greg thought, should be sterilized—though the symbiotic bacteria in contact mission personnel had been altered to lyse autonomously when out of their bodies, there was always the possibility of mutation.

Too many risks, too many possibilities and time would overcome any barriers—contact, he realized, meant that the terrestrial and Eponan biospheres would eventually overlap and become something different. The alternative was a strict quarantine that neither civilization wanted, nor would be able to enforce forever. Perhaps off planet reserves could be established. . ..

Kanti took his arm, and they walked back into the chamber.

The inside walls were a breccia—recent sediment fused together into a kind of cement by pressure and crystallization as it dried. Greg slumped down on the gravel with his back to the outer wall. There was a sharp bump on it, and he moved over. The rock was full of shells and other things.

"Look, Kanti. A dracowolf claw." The semi-intelligent blind predator had been a close cousin of the Uther. Two finger-sized talons curled out from the stone and back in, almost like its owner was still attached and trying pull itself out of the wall. The point of a third was exposed.

"They're extinct, aren't they?" she said.

"As far as we know. Too specialized—they couldn't compete with the Uther when the Uther learned how to hunt. There's still a dwarf species near Fire Island, but it doesn't get over here."

"Bach told me stories about dracowolf hunters. The Uther think they

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exterminated them." Kanti raised an eyebrow. "And are proud of it."

Greg nodded. "Our ancestors were proud of exterminating varmints. They didn't know any better. Neither do the Uther, yet. Which is why letting them out into the Galaxy is so dangerous."

Kanti frowned. "But they already had rockets when we arrived."

Greg sighed. "Yes, they had rockets. But their level of technological development in most areas was not much higher than Mycenaean Greece, or Confucian China. Having rockets is a lot different than having a starport with a relativistic mass beam—especially when you only need seven kilometers per second delta-V to get into orbit."

Kanti looked confused. "If they were so primitive, how did they discover rocket fuel?"

"The fuel is just hydrogen peroxide and oil. Hydrogen peroxide is, roughly, what they use for anaerobic metabolism—its decomposition provides heat and oxygen when Eponan organisms can't get it from the air. Many Eponan organisms store small quantities of it—their equivalent of barrel cacti are full of it. Concentrate it to 95 percent or so with a still, add one part in four kerosene or a similar hydrocarbon, and you have just enough specific impulse to get out of this gravity well. They need a catalyst to add to the hydrocarbon, but that's also found in most of the tissue of things around here.

"Their legends say their first rocket engines were snail shells. Juveniles would put a bowl of juice under one, drop a cup of oil and catalyst into it from a hole on top of the shell, and ride the shell up a dozen meters in the resulting explosion. Then they'd glide back and do it again. It was a way of tricking the Universe out of altitude without having to work for it—like finding thermals. There are murals of them, thousands of years old, getting blasted into the sky."

She shuddered. "Scary."

Greg stroked the point of the embedded Dracowolf claw. Cowards hadn't defeated those monsters. "What do you do to prove your courage when you run out of dracowolves, and war is getting a little too expensive? Exploration seems to be a universal substitute for war, and a sink for the impulses that lead to it." He looked at Kanti. "If we say we agree to its terms, will Bach believe us?"

"Maybe. They haven't killed us yet, so they must think it's possible for us to join their flock. I think they'd try to work us in the way they work in purchased or captured juveniles—plenty of incentives and watched all the time."

"Bach didn't seem entirely happy," Greg observed.

Kanti nodded, not looking entirely happy herself. "It's taking chances. It's been a risk-taker since I've known it—leaving its parent a full two weeks before normal weaning."

"They aren't as stubborn about flock loyalties as humans are about family and country, but they still have it. And they consider consequences—note how carefully Bach's superior rationalized things. The instant loyalty

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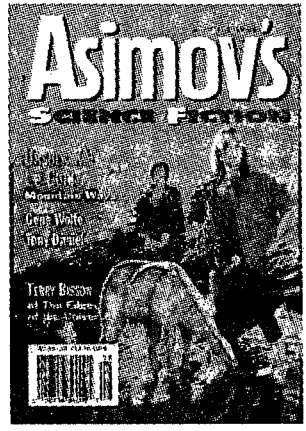

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switching is a overlay, I think, a cultural invention that helped metaflocks evolve. Their emotions still go back to parent and flock. And, as thinking beings, they can generalize flock loyalty to the race and perhaps all thinking beings."

"But your kind of arguments didn't have much effect on Bach," Kanti said. "Its administrative flight leader—that's the title your translator buzzed—offered it more. It was also trying to buy us." She looked him in the eye. "Have they bought any other humans?"

Kanti was no idiot—Greg wondered how much of his fears to share with her. It was his job to watch humans watching Uthers—and some typically human things were happening. Access, artifacts, being first with some data—these were things that could be bought with a little useful technology, and it was easy enough to rationalize that the Uther would get it soon anyway. Or invent it. So why not?

"I don't know for sure, but, Kanti—in a population this size, it's probable that someone's been disaffected to the point of helping them. There are models for that."

"So we're watching for it?"

"Yes."

"*You're* watching for it."

Greg frowned, then nodded. Another deception revealed, as if it mattered now.

"And you're watching me big time because you think my mom might have 'disaffected' me from the whole human race?" There was a hint of anger in Kanti's voice.

Cool, now, Greg told himself. "Not really. Your affinity for the Uther seemed more an attraction than a negation—a pretty positive thing, and interesting, as far as I am concerned."

"I'm interesting. Glad to hear it. Greg, are you my father?" She just blurted it out.

Greg raised an eyebrow. "Kanti, you may as well understand. I decided long ago that my sexual feelings were interfering with what I wanted to do, so I had them modified. You're a beautiful young lady, but you'll need to look elsewhere for a lover, or a father. Besides, I'm at least ten times your age. That doesn't matter physically anymore, but mentally—I've been through a lot."

"Children?"

Greg shook his head. "Almost." He laughed. "She changed loyalties for a better offer."

"Would you consider changing back?"

"No. . . ." How could he communicate to this young, vital girl how free he had felt after the retrovirus had removed his reproductive needs, and he'd closed away that part of his life? He'd gained peace and the freedom to concentrate on the things that really mattered to him.

"Kanti, you'll find someone." Greg stopped. A century ago, almost exactly, he'd heard the same words. What he'd lost in his change, as he looked back on it, was simply embarrassing. And yet there had been a bonding, and memories, sweet once, turned to ironic farce by subsequent events. Now, in a second, the same empty, betrayed feeling touched him as if

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those years had suddenly vanished. *That* feeling had not gone away with the lust.

He thought for a moment that perhaps he could spare Kanti that by pretending, or perhaps even reversing.... No, if he changed back, he'd risk the same thing happening again when and if Kanti found something better, and if he pretended, the relationship would be an act on his part—a false, comic farce. He smiled at the girl. "I don't dislike you, I care about you, I'm your friend—maybe we can leave it there?"

Her eyes were glistening. "Crap," she said, then took a breath. "OK. I can deal with it. The Uther don't form couples either. Hardly think about sex out of season. Maybe it helps you understand them."

"Well, maybe." Greg shrugged. "Now, let's try to think of a way out of here?"

They both sat and thought. Greg tried to think about the problem, but fatigue and other thoughts took his energy. He slumped against the stone wall to be more comfortable, and finally lay down on the sand. The light was almost completely gone.

Someone was shaking him. "Greg, Greg, wake up."

He was not in his alcove on the island. He was—gravel—Kanti. "Uh, sorry. Fell asleep."

"Look. Since we don't have wings, the Uthers don't think we can fly. Right?"

Greg blinked hard. She woke him up for that? He shook his head. "That doesn't seem surprising."

"I can dunk a basketball here. That's three meters. If you throw me up at the same time, maybe I could get another half meter or so. I think that's enough to reach the second floor window sills."

Greg looked at her. She wasn't particularly tall, but he'd seen women not much taller jump that high on Earth—and they had only three-quarters Earth gravity here.

He tested his arms—they were sore, but seemed to have recovered their strength.

"I guess it's worth a try. It could smart a little, crashing into that stone wall."

Kanti puckered her lips. "I can handle it."

"What window should we try?"

She smiled. "Maybe one of the ones near my latrine?"

Greg laughed. "For all we know, these carrion-eating Uthers might like the smell. But it's on the opposite side of this building. After we get up, we have to get down, and that looks like a three or four meter fall from the balconies on this side."

Kanti gestured to their rations. "We need something to carry this in."

Greg thought a moment, then patted his stomach. "Let's carry it here. They say food is sleep, and we won't be getting much. In fact, we should rest a little now, until it's darker."

They broke out the food and stuffed themselves. Then they lay down in the gravel.

Kanti shook him. He hadn't meant to be out so completely again, but it was probably just as well. When he had his wits about him, they stole out

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into the courtyard.

Kanti's spot of fertilizer was actually between the ranks of windows, and any odor had long since vanished. They chose the window to the left. With Kanti's heels on his shoulders, her toes in his hands, and one hand on the wall for balance, they both crouched. On "three," he jumped up, and she jumped as soon as she felt him move. It finished with his pushing her toes up and away.

Surprisingly, in view of how the rest of the last twenty-four hours had gone, Kanti reached the window ledge on the first throw. She was able to find sufficient purchase on the walls with her shoes to lever herself up enough to get an elbow up. Then, like a human snake of some sort, she slithered in over the window sill and thumped into the pitch black room.

Greg waited in the courtyard below. If an Uther looked in on him, there was no sign of it. Eventually he leaned against the wall.

Something was brushing his face. He opened his eyes—an electrical cord. He looked up. It was pitch black, with nothing but starlight coming down the well of the five-story Uther building, but enough to see by—two bright planets were overhead.

He pulled on the cord. It jerked back. Clear enough. He pulled steadily, then put his full weight on it. OK. Only four meters or so, he told himself. He'd seen people go up whole mountains this way, but he'd never done it. It wasn't pretty—he leaned back and got his feet on the wall, then kind of duck-waddled up a foot at a time, advancing hand over hand on the cord until he finally got his legs over the sill. His arms burned with the effort.

The room was a mechanical shop of sorts—with what felt like lathes and presses. They couldn't really see anything clearly. The cord Kanti had found was still attached to its machine, which, presumably, was bolted to the floor. There was one bank of outlets on a far wall, which, presumably, was why the cord was so long. Electricity had been added to this building long after it had been built.

After a couple of minutes for him to catch his breath, they went out to the balcony.

Four meters down on this side, too. But they had the electrical cord.

Three hours later, they'd managed to steal several kilometers downhill from the Uther building, and Greg stopped at an open place on a small hill to take a look at the sky. Borvo, almost as bright as Jupiter from Earth, approached the horizon, still bright enough to shine through the thin, luminescent clouds. It set about 0300 local time—without a large moon, Eponans of all sorts used the giant planet to time the night. He looked a quarter turn right of Borvo, trying to find a hole through the canopy of pagoda trees along the horizon.

"There, Crux! That's north," he finally said. The Southern Cross in Earth's sky, Crux lay near Epona's north pole. So downhill was roughly west, toward the field of camouflaged spacecraft. They had probably been managing a couple of kilometers an

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hour over easy, if squishy, terrain.

"Does it look that way from Earth?" Kanti asked.

Her question sent a twinge of nostalgia through Greg, and then a touch of wonder as he remembered Kanti was a human who had never been to Earth.

"Pretty much," Greg answered. "Its nearest bright star is a couple of hundred light-years away—a shift of twenty-one light years doesn't make that much difference. But it's a *northern* cross here."

Kanti sighed. "Sometimes I feel homesick for Earth, which is silly because I've never been there—and if I did go, I'd probably feel homesick for here. Makes me wonder if I belong anywhere."

Greg touched her shoulder. "Someday, maybe, you'll visit one of those stars, and look back to find that the distance between Epona and Earth is less than the width of your hand."

He stuck his hand out to illustrate the point.

"Oof!" With no warning at all, something clamped onto his arm like a vice. Kanti's "Look out!" and a rustle of round leaf penetrated his attention well after the bite. Something that looked like a cross between an alligator and a clam was trying to saw its way through the arm of his bodysuit. A single long, muscular leg flailed away in the air. Greg, instinctively, kept his arm out stiff, keeping the leg and its single claw away from his lower body.

"Springcroc!" Kanti finished her warning. Then she grabbed the upper "jaw" from behind the thing while Greg grabbed the lower one with his other hand and pulled.

An audible crack ended the drama—the thing's upper carapace fractured and bent up, releasing Greg's arm. At the same time, the springcroc started shaking like a leaf, then went still.

"You OK?" Kanti asked.

Greg tested his arm. "Sore as hell, but it still works. Look at that thing!"

"It's dead." Kanti said, kicking it to make sure. "The cracked shell went into its brain, right between the eyes. It wouldn't have lived long anyway—look, its eyes were rotting away—it probably couldn't even see what you were. We were lucky to get it off."

"This isn't going to be a walk in a park, I see," Greg said, rubbing his sore arm.

"Don't worry, ones that big don't normally get this far inland. And they can't eat humans."

"Right. If they can tell we *are* human. With that, it was bite first, taste later." Greg almost felt sorry for the big old springcroc—old and feeble and clearly blind, it had kept doing its jump and bite thing to the very end.

"We can always go back to the tower."

Greg shook his head. "No. Let's go. That way." He pointed west.

Kanti shrugged and plunged into the pagoda tree forest. Greg noted how she kept her arms close to her body, and did likewise.

The sky started to become gray. Kanti stopped at a particularly low and broad pagoda with helicopter vines draped all over its base canopy, their ends twirling in the light breeze.

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"I need some sleep," she said simply.

Greg, exhausted as well as worried, nodded. He had no idea of how far they'd come, his arm was killing him, and the whole enterprise felt futile. He worried about how crude his navigation was, and his only feeble hope was that the field of disguised Uther rockets was too big to miss if they were headed in anything like the right direction. He worried about whether they would get there in time to do anything.

"We'll need about ten rocks and a giant roundleaf," she said. A nearby stream provided the rocks, and a mystified Greg helped her lug them back to the pagoda tree.

It all became clear in a moment. Kanti pulled the vines down until the edge of the pagoda tree's canopy touched the ground. Then she weighted it there with a rock. She did this all around the tree until she had turned the umbrella-like canopy into a kind of fluted tent that looked something like a furled umbrella.

With a sharp stone, they were able to cut off the top of a giant roundleaf nearby, and tear it in half. Each half made a sleeping pad. Kanti lifted one rock on the rim of her "tent" to make an opening, and pulled the pads in. Greg followed and closed the "door" by curling the lip of the canopy back under and weighting it down from the inside.

By midday, it was too warm to sleep any longer. Greg started to get out of the "tent."

"The Uthers have sharp eyes," Kanti said.

Greg looked up, involuntarily. "We've got to make some progress. They must be almost ready to launch their attack, D-flat Seege must realize he can't keep a lid on this forever."

"Right." Kanti said, looking up as well.

"Well," Greg said. "I think they'll be looking for something from the air more than from the ground. Bach doesn't know you, and it would expect me to try to get home instead of going for the rocket field. So maybe they won't be watching too hard." Greg moved carefully out of their tent.

"Maybe." Kanti rolled to her feet and followed him.

They moved carefully under the forest canopy for about an hour. Judging by Taranis's position, they were still headed approximately west, but Greg was beginning to mistrust his navigation, particularly when the terrain started rising again. It would, he thought, be best to wait for nightfall when he could get a look at the stars again.

"Greg," Kanti whispered. She was at the top of the rise.

He scrambled up to her and looked. "What is. . . ." He fell silent in awe. Even from this slight hill, the huge, blunt shapes towered over them, and there seemed to be hundreds of them, stretching right and left until distance blended them into the surrounding forest. From the average spacing of the rockets, Greg was able to confirm his original estimate. Probably a thousand of them. One Uther warship for every human being in the system, he thought. Even given the disparity in

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technology, if that fleet boosted without warning, it would be all over in hours.

The Fay D-flat Seege had made little effort to disguise their fleet from ground level, other than randomizing the placement of their rockets to simulate a pagoda tree forest. They had, however, taken the precaution of surrounding the rockets with an innocent looking belt of thin forest and meadow—anything in that belt would be very easy to spot from the air.

"Down, quickly, quietly. Sentries," Kanti said.

Greg didn't see anything, but moved quickly. They scrambled beneath the lowest leaf of a large pagoda tree.

"How did they do all that secretly?" she asked, her voice filled with quiet wonder.

He shook his head. "We screwed up. When your forces are inferior in weapons, skill, or position, your best bet to make up for that is with superior numbers and that was what we should have been looking for. They were more audacious than we realized and did a damn good job of camouflage."

"I don't think we'll be able to just walk in there," she said.

"No," he agreed. "Let's back off and try to think of something."

They retraced their steps for a few hundred meters, and sat down near some exposed rocks. Finally Greg asked, more to break the gloomy mood than anything else, "Is there anything here we can eat?" The conventional answer was "no," but Kanti's field knowledge had surprised him enough so far that he wasn't going to make assumptions.

Kanti shook her head. At length she said. "Maybe. The pentapods and their relatives are as poisonous to us as we are to them. In theory you could eat snail flesh, but you would have to cook it a very long time, or the digestive juices would burn your mouth, throat, and everything else. Springcrocs are full of other poisons. But. . . ."

She stopped and went over to a small rock, then turned it over.

"They look like beetles," Greg said.

"They *are* beetles." Kanti announced. "Terrestrial insects—they can eat the moss here, and some of the dead Eponan life."

It wasn't supposed to have happened. The precautions against contamination had been immense, and draconian.

"Mom." Kanti said. "She brought a sealed terrarium with her, a little glass thing the size of a baseball that had its own simple independent ecology. She didn't declare it, and took it in her handbag. She bragged about getting it through. It disappeared when I was five. She told me to never say anything." The pain of a broken promise was etched on Kanti's face.

Greg could guess what had happened. An Uther juvenile had scavenged the little terrarium, then broken it open to see what was in it. In, what, eleven years, with plenty to eat and no natural enemies, in this hothouse. . . .

"Who knows about it?" he asked.

"Bach knows. And probably his wing leader's file right up to D-flat Seege. They aren't mad—they didn't

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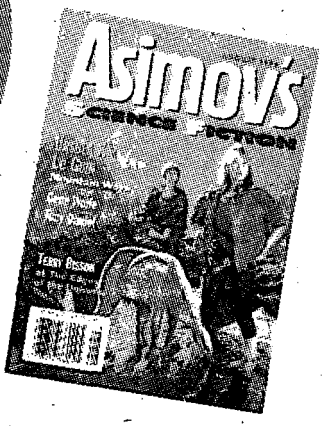

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believe our promises of not trying to take their planet in the first place and expected us to try to trick them out of it—because that's what they would have done. They thought it was kind of clever, sneaky. Now they're going to try to get even." She hung her head and stared at the loam and the alien beetles. "Greg," she whispered, "will they kick us out of the system altogether?"

Greg shook his head. "Probably. If Knute doesn't do it first. But I think it's already too late."

Kanti shrugged, and picked up a beetle about the size of her little fingernail. "In the meantime—" She popped it into her mouth and chewed ostentatiously, staring Greg in the eye.

With an extreme effort, Greg did the same. It wasn't as hard the second time. In half an hour of turning up rocks along the stream bed, they managed a decent snack. It was mostly protein, he told himself, and better than nothing.

It was late afternoon now, and they found themselves by an idyllic stream, warm but not too hot. The leaf ribs of the tall pagoda trees that lined the banks reminded Greg of the vaulting of a cathedral—a translucent cathedral in unearthly shades of green. But for all the beauty around him, Greg felt the lead weight of responsibility on his shoulders. "How long do you think it would take us to walk out?"

Kanti shrugged. "A week. Maybe two—if we survive and Bach and his friends don't find us first."

D-flat Seege would make its move well before then. How the hell, Greg asked himself, had he got himself into this? He had no communicator, no food, no weapons and the one Eponan ally they thought they had would probably kill them on sight.

But if they didn't try to do something, the starbase would surely be overwhelmed by the sheer numbers of a surprise Fay D-flat Seege attack. They would be forced to either kill thousands of Uther, or run. The former was unthinkable—but if they did the latter, there would be literally no limit to the Fay D-flat Seege's ambition, and perhaps its revenge.

"I'm going to have to go in there. If they have human electronics in those Uther spacecraft, I might be able to fly one of them. Part of my job is to manage technology transfer—so I know both ends pretty well. But the voice interface would be Eponan. I'd like your help. It will be dangerous—damn dangerous."

Kanti looked at him, eyes glistening, but her face determined. "I know how important this is. I'll take risks. I already have." She shook her head. "But I'm not too good with technology. I probably don't even have the vocabulary. And I don't want to commit suicide."

Greg pursed his lips and thought for a moment. "There would be just a limited number of commands. Numbers, simple actions like on and off or increase and decrease, and nouns for rocket parts. Maybe you could teach me enough Eponan to do that."

"I don't know. It's hard—especially if you can't sing."

"I can whistle. Try me."

"OK, but I don't think this will

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work." She took a breath. "In the GCH dialect, which is what I know, position is indicated by dividing directions into threes; the high tonic—it's not really a tonic, off by about a quarter tone, but that's as close as I can describe it—tells you if the object is high, level, or low. The near subdominant chord tells you whether it is front, even, or back, and the dominant whether it is left, right, or center. That gives you one of twenty-six prime directions, and you can modify that by the pre-motes for more or less." She sang three notes in rapid succession, the second higher and the third lower than the first. "I can't sing three notes at once, but if I sing triplets with a rest between, they understand me. I just said 'Object more high front right is.'"

Greg got a sinking feeling. This was very complicated, and he just wasn't able to remember.

"They break distance," Kanti continued, "into steps of near, away, and far three times. You've got to remember the order; near-away-far is closer to you than away-near-near."

Greg shook his head—even though his life might depend on it, he couldn't absorb it. He was tired and having trouble concentrating. He might, he thought, be able to work it out from a sketch, but he'd never absorb enough to use it quickly in a crisis. Besides. . . .

"You said GCH dialect. This isn't universal?"

She shook her head. "The concept is pretty much the same in other dialects, but the pitches may be different, and some sing range before direction."

There would, he realized, be no quick study of Eponan for him. Without his translator, or Kanti, he would be an illiterate deaf-mute mime. Maybe he could get something, though.

"Could you sing the, uh, high tonic note for 'near' again?"

She did, and it was in his range. He tried to duplicate it. She laughed, and sang it again. This time he got it about right.

"Could I use that for a warning?"

"Maybe. If you do, sing loudly—that would let them know it's important, and maybe an Eponan-speaking computer too. And repeat it three times—that's the nearest possible."

He tried it again and she smiled at him. "I think that's barely adequate Eponan neonate talk. Want to try translating Shakespeare now?"

They both laughed, but the laughs had an edge to them.

"So, what do we do?" Kanti asked.

"I'd tell you what to say. Try, 'increase the oxidizer to fuel ratio' in Eponan."

"Huh? Greg, I'd have to understand what you were saying in English to translate it. I'm afraid that learning that would be as hard for me as learning Eponan for you."

Greg thought about it. How much would be automatic and how much user-selected? Would he have to deal with mix-ratios? Pump rates, or would it be pump pressure, or could one just select a specific impulse? How could he select an escape instead of an orbital trajectory? And if the latter, how could he specify an injection vector—he remembered Kanti's description of how the Uthers indicated direction.

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"Can you fly a ship without the computer?"

"Not a human spacecraft—but an Utheran? Maybe. They used to fly them manually. Anyway, I've got to try. There will be a holocaust if we don't. Maybe, if I'm sneaky enough, I can spend a few hours in the cockpit unbothered and figure out the computer—or figure out the manual controls. At least I might blow it up and start a chain reaction, one ship explosion exploding another."

That sounded very close to suicide, he realized.

Kanti looked at him and sighed. "After we get away?"

We? She was going in with him. "Yeah," he said, not very convincingly.

After a long time she nodded.

He looked up and watched the pagoda trees sway in the cooling evening wind. Their helicopter vines twirled in the ruddy embers of the last rays. Greg felt the warmth of Kanti's thigh against his right leg and memories of the kind of tingling sensation he used to get from that went through him.

Except that he shouldn't feel that now, and, anyway Kanti was on his *left* side.

He tensed and looked quickly at his leg. A sheet of flesh had somehow moved from under the rock next to him and had flowed up the side of his leg. Out of this sheet of flesh poked a number of tiny stalks with little black dots on them.

"Yuk!" He jumped up and started rubbing his leg furiously. "Nothing like sitting there thinking everything is going to be all right in the world, then finding out that something's eating you."

Kanti laughed. "It's just snail slime—the real strong stuff is further inside. Rub it with a roundleaf—they've got a natural neutralizer."

Greg uprooted one of the ground cover plants—a kind of dwarf pagoda tree, he recalled—and rubbed its large, crinkly, leaf over this thigh. The stinging sensation, indeed, vanished. "I guess that's a message that we'd better be about our business. First we have to get in. They've got sharp eyes and lots of surveillance—probably alerted now that we've escaped." He looked at the snail that tried to eat him. "Maybe if we found a couple of big shells and crept up a little at a time.

"That's an idea, but," She looked at him with a mischievous grin, "how's your stomach?"

"Why?"

"Are you up to being eaten alive?"

Halfway back to the disguised launching field, they found a snail big enough for both of them—a huge, ancient specimen covered with miniature parasitic pagodas. Its roughly hemispherical shell was almost two meters at its highest point, dented in numerous places and partly covered with the Eponan equivalent of moss as well as parasites. It looked like a big, old boulder.

Kanti dug through the loam and found a rock. Then she scraped part of the shell clear and began to chip away.

"I thought you wanted it alive!"

"I'm not killing it. We'll just need a little hole to see out of, and some

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places to attach some slings. Our suits are pretty good, but we won't be able to sit right on the stomach wall. Get a rock and help."

The snail seemed completely oblivious to what she was doing, and soon she had a hole chiseled through its shell. Then she started on another.

Greg found a pointed rock. "How many holes?"

"One to see through, one to steer it with, and four others to anchor our slings—a pair here for me and back there for you. We'll cut some vines and wrap the ends around rocks too big to fit through the holes, and let the other ends dangle inside. We can finish the job inside."

"Standing in its stomach?"

"You've got the picture. It's really more of a colony of cells than a true multicellular organism. The cells are only partly specialized, and they part with each other fairly easily, and they can change specializations. If you pet an eyestalk, it will start trying to digest your hand."

Greg shuddered, and got back to chipping. The shell was full of bubbles and wasn't exceptionally hard—though obviously strong for its mass. It took less time than he thought.

"OK, what now?"

"We've got to make a trail of snail goodies, leading as close as we can to the field. Let's find a pagoda nut tree. Strip off the shells, and the meat inside is snail caviar. Pull off the helicopter vines, too. We'll use those to support us inside."

Finding and gathering the nuts was two hours of exhausting work. They scraped out the inside of a barrel section of a fallen pagoda tree to make a bag for the nut meat. They used that to lay trail to within a few hundred meters of the field over ground level enough for the big snail to pass. That took them to sundown. Then they filled the bag with nutmeats again and went back to the snail. It hadn't moved.

Would it ever move? Was this whole idea a time-wasting idiot's errand?

Kanti laid some nut meat directly in "front" of the symmetrical giant snail, that is to say *beside* it, in the direction they wanted to go.

It did nothing.

She pushed the meat closer.

They waited.

Finally, a band of tissue flowed out from under the shell, and a couple of eyestalks grew out of it and waved around. It came almost as a surprise to Greg that the distance between the shell and the nutmeats had grown less—there was no sound at all above the rustle of windblown pagoda leaves and occasional three-prong hoots. Yet in seconds, the snail had moved over the offering.

They followed the snail for five hours, until it was within two hundred meters of the launch field perimeter.

"Ready?" Kanti asked.

"You're sure you've done this before?"

"Once, when I was eight. Wipe yourself with the roundleaf. Then lie down beside me and put some nut meat on top of yourself. Cover your face with leaves and stand up as soon as you're inside."

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A minute later, he was lying down holding leaves over his face with his hands, passive as an offering to some omnipotent god, waiting to be eaten.

It didn't take long. The snail's dim nervous system had gotten used to finding nut meat in their direction. Warm folds of flesh enveloped his boots, his legs, his chest and arms. Despite himself, he shook. Despite the coating of roundleaf juice, an itching, burning sensation began to take over his nether parts.

The flesh flowed over his hands and pressed the leaves to his face. It was warm, rubbery, and smelled of many, many dead things. He sucked in a last lungful of air.

Then the pressure lessened—he must be under the shell. He felt himself lifted—the snail's banded foot muscle was pressing him upward into its prime digestive layer. He sat up, and the flesh flowed easily around him. He was in air again—if that's what you could call the rank, fetid, putrid gas in the snail's pulmonary cavity.

Kanti was already standing beside him, and reached down to help him up. They were moving noticeably toward the "rear" of the snail, their boots on the ground, as its "foot" flowed around them. A small springcroc appeared in the purple folds of snail flesh around his boots, opened and shut its jaws once, then was still.

"Like this," Kanti said. She grabbed two of the vine ends hanging down from the holes in the "front" of the shell and tied them together in a square knot, making a loop. Then she hoisted herself up and sat in the loop.

Greg had to "walk" a couple of steps through the grisly flesh before he got his seat right, but he finally managed it, and was rewarded by the tough vine making an uncomfortable dent in his buttocks. But at least he got his feet out of the snail's digestive layer.

The itching feeling did not go away, however. There would, he realized, be nothing he could do about that until they were out of the shell. He looked down at the springcroc. The outer layers had already been stripped from its foot, showing tubes of smooth muscle. An eye hung out of its socket, and dropped out as he watched, its optic nerve or whatever dissolving in real time.

He looked up at the dome. The pulmonary cavity was lined with a thin layer of cells as well, and glistened in a mucousy sort of way. It was the job of those cells, he remembered, to maintain the shell—over time their holes would be filled in by fresh silica sponge. At least they didn't drip on him.

Kanti had her face near one of the holes they'd chopped in front of the shell. "So far, so good." She stuck a hand out and dropped some nut meat in front of the snail. "I hope I brought enough."

The shell glided forward—Greg could tell by the slight changes in pitch as they went over the rough forest floor.

An hour went by, then two. Greg's rear end was killing him, he tried putting a hand between his rump and the vine. Pretty soon, the hand started

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hurting. Kanti said they were getting closer to the field, but progress was, well, at a snail's pace.

Three hours into it, she turned from the eye hole. "Will you shut your eyes for a moment?"

"Huh? Why?" The failing twilight that slipped through the holes in the shell was hardly enough to see anything with.

"Let's just say I have to feed the snail."

"But you're . . . oh."

He shut his eyes, there was some rustling, some spraying, and a whiff of ammonia that was almost refreshing compared to the general bouquet of the shell. At length she said she was done, and he opened his eyes again—and saw nothing. Night had fallen.

"Can you see anything?"

"Some stars—maybe a clearing ahead. The Uthers don't light defense perimeters—their sentries depend on night-adapted vision, and lights would ruin that for them."

"Great."

"Don't worry. These snails wander all over the place at night, though one this big is rare."

Another hour went by. Greg developed the habit of moving his rear end every five minutes or so, so the vines didn't always press in the same place, *before* his rear started hurting. This helped.

"We're across the clearing. Is the first rocket we get to good enough? I can see its silhouette against the Milky Way."

There was nothing Greg wanted to do more than get out of this putrid snail. But the Uther perimeter would have the most surveillance.

"Let's get a little farther in, if we can."

Kanti shoved more nut meats out the hole in the shell. Gradually, they glided onward.

"We're about four ranks in now, it's beginning to get light, and we're about out of fuel."

There was no possibility of staying another day in the shell. "OK. Let's get out," he said.

Silence.

"Kanti. How do we get out?"

"The way we got in, I think. If I can throw nutmeats far enough ahead of the snail, but. . . ."

"We're out of nutmeats?" Greg imagined the snail losing the nutmeat trail and stopping with the edge of its shell over his head.

"Just about," Kanti said in a very small voice, "and I can't throw them very far through the hole."

"How did you get out when you were a kid?"

She sighed. "The other kids lifted the shell."

They would have had to stick their hands right through the outer mantle—but snail flesh parted easily. Maybe . . . "Maybe we can lift it from the inside?"

"Yuck." That was heartfelt, but somehow sounded hopeful. "But I think it will work."

"I agree. Yuck. Let's get going."

They eased off their perches and forced their boots through the rubbery slime. With effort, they moved toward the "rear" of the shell.

"Will this kill it?" Greg asked. It seemed they were doing hideous

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damage to its innards.

"You don't kill a giant snail. The question is, are we strong enough to lift this shell and tear our way out before it kills us. It took five kids, as I remember."

"Right. Well, as I see it, to get the edge we have to thrust our hands through this goo—" a springcroc skull stared at him, eyeless—"lift the edge, and then duck our heads through, under and out."

"Right." She said. "I'm ready."

"OK," he said.

"On the count of three?" she asked

"Right. . . ."

She started and he joined in. "One. . .two. . . *three*."

He took a deep breath and shoved his hands through the slippery wet folds of the snail's stomach. They started burning immediately. He forced them through and out, found and grabbed the rim of the shell. It was slippery and burned, but he hung on, bent his legs, and *lifted*. Gradually, with an ugly sucking sound, the rim rose with the snail flesh stretching into a mucous curtain between the rim and the main body below. Kanti grunted, straining on the verge of tears. Waist level was as high as they could get the edge of the snail.

"You go first. I'll hold it up for you. Then you try to slow its fall while I duck through. Hurry."

Without a word, she plunged her head into the snails stretched stomach wall and struggled through it. When he felt her lifting again from the outside, he took another breath, shut his eyes, and butted his way through it, too.

The goo clung to him momentarily, then he tumbled free outside—the curtain of flesh was thinner than it looked. He didn't dare open his eyes. A hand put some roundleaf in his and started scrubbing him. He immediately started wiping the slime off his face and hair, then his hands. Gradually the burning feeling departed. He would, he figured, end up with a hell of a rash.

When he finally risked opening his eyes, he found that Kanti had finished cleaning herself and was laying a trail for the snail to take it away from where they were. She looked at him and shivered, then smiled. "Yuck."

He smiled back at her. "At least we've got a tale to tell."

"Yeah. Which ship are we going to steal . . . or blow up?"

"They all look the same. The Uther must have an assembly line somewhere. Uh, that one." He pointed at one of bullet shaped "pagoda tree" trunks at random. Up close, the camouflage wasn't really that good—a canopy of fine mesh screen braced with sticks of what Greg assumed was fiberglass and painted to look something like a pagoda tree canopy when viewed from above. No, he thought at second look. That was probably a real pagoda tree canopy on top of the screen, cut from some tree. In this season, it would be hard to tell a dead one from a dormant one.

With a start, Greg realized he could actually see the Uther rocket; a glance at the sky revealed only the brighter stars and planets. Dawn was approaching. "Let's *go*," he said.

They ran for the spacecraft, or as

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close to doing so as they could—the roundleaves were dense and tugged at their feet. The ground beneath was soft and squishy. They made progress, but ten meters from the rocket, the ground suddenly exploded in front of them with a burst of light and a deafening sound. They hit the roundleaf.

Before they looked up, they felt the backwash of Utheran wings above them. Triads of Utheran tone language rained down on them.

"It's Bach," Kanti said, her voice breaking ever so slightly. "It says 'Last song, us human must now sing.'"

The Uther glided down out of the dark to a five point landing in front of them and smoothly assumed a high dominant posture with its gun pointed at the humans.

Greg stepped in front of Kanti and braced himself. He had to try to disarm the Uther, then. . . .

Kanti touched his arm. "I, I don't think we should panic—if we really had to be dead, we would be already. It's just stating his opening position. It'll listen, I think." Kanti was still trembling, but her voice was firm. "Sit down. Now!"

Greg sat. Kanti got down on all fours and sang six triplets. "I said, 'Right things for all, we humans try to do. Sorry to parent humans, this human is.' Understand? It knows a little human body language, so try not to look dangerous."

Greg crossed his legs and held his hands out. It must have worked because the Uther didn't shoot. Something immediately started trying to gnaw on his boot. He ignored it. Could they just keep the Uther listening long enough to think of something? "Kanti," he whispered, "tell it to spare us and we'll leave, and we won't let them know it let us go. Surely it doesn't want to kill you. It's lived with people all its life—try asking it to trust us."

Bach raised his gun and took aim.

"Huh?"

"Shut up!" Kanti looked at Greg in horror and shook her head. "We're not in the same flock anymore. That's a terrible insult, taking it for a fool; and it knows some English. You're lucky it didn't kill us right away. Leave this to me, please."

How many times, Greg thought, *had he mentioned trust to Uthers in the course of arranging support for human investigators?* Such mentions, he recalled, evoked indifference—a sophisticated Uther tolerance, he now realized, for bad manners. He'd considered himself an expert on Uthers—and compared to Anna, he was. But he hadn't lived with them like Kanti.

Kanti began singing triads, but the muzzle of the gun stayed pointed.

Bach returned Kanti's song—Greg thought he could even recognize some motes.

Instead of translating, Kanti sang again. Greg shuddered, utterly helpless in the plants and muck while his fate was being decided in a language he did not understand. He still had thoughts of rushing the Uther—they were relatively slow and weak on the ground, but their reactions were very, very good.

The Uther lowered the gun and motioned to the spacecraft.

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"What?" Greg asked, in wonder. "You talked it into letting us go?"

"No, that kind of pleading doesn't work." She set off for the spacecraft.

Greg followed her, with a look back to Bach, who was walking behind on the three-fingers of his rear wing in a way that should have been as clumsy as a human on crutches, especially in the roundweed, but somehow wasn't. Instead, the Uther seemed to flow forward, the folds of its furled rear wings draping down like a skirt and giving the impression of a medieval bishop in robes. Greg had never seen an Uther take this dominant moving posture with humans before. Perhaps, he thought, it was for the benefit of any other Utheran sentries who might be watching.

"It's not letting us go? But it hasn't killed us. What did you do?" Greg asked.

"I bribed it. I promised that it could go to Earth and hear Bach played on the original acoustic instruments. I promised it membership in our flock, if our airlords agree."

An Uther on a starship? Was that a promise that they could keep? "Why the gun?"

"It's not a fool—it'll hold the power of life or death over us until we fulfill our part of the bargain."

"I see." This was, in some respect, more of a kidnapping and hijacking than an altruistic aiding of friends—but, of course, that was how a human thought. The Uther, who had already deserted one flock for survival, was simply doing the same for fresher meat. "If we don't take it?"

Kanti spread her hands. "It'll be killed here, and if it tries to go back to GCH it will be killed there as well. It might join some metaflock military, but at a much lower position than what the Fay D-flat Seege offered it. It's taking a terrible risk."

It needs a flock, Greg thought. Well, in theory, the human station belonged to one. "Maybe Fay Seeffay would take it, since we're supposed to be part of that metaflock, now."

"No, Bach needs more than to be the lone subordinate of an alien subordinate. It's a proud Uther now, a flock of one—I had to offer it a bribe that would not be an insult."

An expensive bribe in terms of resource allocation. Greg pondered what would be required for life support of the alien for the thirty-year voyage, even with most of it in suspended animation. Did we even know how to do suspended animation of an Uther? He didn't know. His mind spun.

Then they were under the ship. Beneath the pagoda tree leaf umbrella disguise, it was the typical Uther blunt wedge design, but Greg had never seen one from this perspective before. Set up in its base were ten rocket engines mounted 2-3-3-2 on a triangular grate with slanted truss rods taking the thrust loads to a central pivot point, which, from the plumbing, appeared to pass fuel as well as loads.

Five huge propellant tanks loomed above this, four hydrogen peroxide and one of light oil. The life support area would be in the nose, of course, twenty meters or so up. Standard Uther designs had a hatch up there on

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the outside that swung down to form a landing balcony. But the sides of the ship were clean of anything to climb, and too flimsy anyway—made of thin, horny refractory material that was only slightly stronger than cloth. When fueled, they relied on internal pressure for rigidity.

"OK," Greg asked. "How do we get in?"

Kanti sang triads, the Uther sang back.

She translated. "Spacecraft humans try to steal without knowing how?"

"Providence!" This was not going to be easy, Greg realized, not in a long shot. The Uther had all the options—and if they failed, it could always shoot them and claim to have just captured them.

He thought furiously, conscious of the lightening day and increasing danger around him. The Uther ships had airlocks somewhere—but that flight balcony did not have an airlock door. It led directly to the main cabin. He tried to remember. Had he seen Uthers emerge from the base of their spacecraft in orbit?

He studied the tangle of pipes, cylinders, and cables above. There was nothing resembling a ladder, but various pipes and struts were in reach.

"I think they have an airlock leading to the propulsion section." He pointed up. "Ask him."

Kanti sang a few notes and Bach looked up the central shaft for a moment, then replied, softly.

"It said 'a door, up there, is but—up there, Uthers, cannot fly to. Up there, this human, climb?'"

Greg shook his head. "Up there, this human will try to climb. Kanti, I'll need to stand on your back to get a handhold. Can you handle that?"

"I'll try. Where?"

The bell-shaped engine expansion nozzles had a ridge around their lower rims. He might be able to grab that and pull himself up. "Let's try here," he said, indicating a spot below an engine nozzle.

Kanti knelt down on all fours and Greg put his hands on her shoulders, then, as gently as he could, stepped up on her back. He straightened up slowly, fighting for balance. The rim of the bell was just beyond the reach of his fingers.

"I'm going to have to jump for it."

"OK," she gasped.

He jumped, grabbed the bell, and held on for a moment. Then there was a loud crack, like a gunshot, and the engine nozzle tore off, dumping him on top of Kanti and tumbling them both into the broadleaf.

Bach warbled and pointed his gun at them.

Kanti picked herself up and sang some plaintive notes back at it.

"We'd better do something fast."

"Yeah. Look for another rocket."

"Are we going to try to sabotage all thousand of them this way? I don't think my back will take it."

"Maybe you can climb up and open the lock?"

The teenager shook her head. "I wouldn't have any idea of what I was pushing, or climbing on. It's almost light."

Greg thought furiously. "Maybe Bach could find one with its balcony-hatch open."

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Kanti shook her head. "It wouldn't be able to get us in if it did. And it won't leave us alone."

Greg shot a glance at the Uther and its gun. "We'll just have to try another rocket. Maybe we can find some rope or vines and hook them on something more solid." He looked around, and saw nothing but roundleaves.

"Greg, look!" Kanti pointed back the way they'd come.

Greg didn't see anything. "What?"

"The snail, it's gone under a rocket. You could climb on that!"

The shell was almost two meters high at the top of its dome, less than half a meter under the exhaust nozzles. In an instant of clarity, he understood why the nozzles were so far off the ground.

"Tell Bach and let's go."

Kanti sang a translation and started off at a run. Greg followed. The Uther passed over him, gliding toward the peripheral spacecraft. The horizon was light blue now, and only a couple of planets were visible. Various diurnal life forms were starting to stake out their territories with various noises.

Slow as it was, the snail had almost passed under the edge of the rocket by the time Greg reached it. Without hesitating he took three huge squishy strides right at the thing and tried to run up the shell, grabbing for the parasitical vegetation that covered it.

His hands slipped—then found one of the eye holes they'd punched through the shell earlier. Using that purchase, he reached one of the swing-anchor holes. Holding on there, he was able to swing his foot up to the eye hole. With that anchor point he was able to grab a thick layer of "moss" on the upper flatter part of the dome. From there, he belly-crawled to the top of the dome.

It had almost passed under the side of the rocket. Then it stopped. Greg looked down—Kanti held her bare arm flat on the path of flattened roundleaf—and the snail started to crawl back over it. She pulled it back and it flowed a little closer.

Greg turned his attention upward. In a minute, he was able to stand up between the hull of the rocket and the outboard engine. The engine gimbal arrangement became clear—the entire engine platform could pivot in one direction, and the pivot axis itself could tilt in the other. It looked as if the arrangement could allow maybe 15 degrees of gimballing in all directions.

There were no gimbal motors that he could see, but there were what looked like tension cables running just inside the hull. Those should be strong enough to support his weight. He grabbed hold of one of them and pulled. It was bowstring taut and held his weight easily. He grabbed higher up with his other hand and squeezed himself slowly upward, pulling hand over hand on the cable, shuddering as various projections on his suit rubbed the pressure-taut tanks and created an ominous bass groan. There was a smell of clean Eponan fiber to the air here, with just a hint of oil vapor. He worried about sparks far too late to do anything about it.

Finally Greg emerged, carefully, into a crawl space below the pressure cabin. It was meant for zero gravity use—no solid handholds. But he

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could see what looked like a hatch cover near the center of the cabin's rounded bottom. Maybe, he told himself, just maybe this was going to work.

He rested his sore arms as he studied the arrangement. The control cables ended on levers attached to rods that projected from the cabin floor surrounded by what looked like the concentric circles of a constant volume joint. No electronics, no optics, and no sliding bearings through the sealed cabin floor—the levers could be worked from inside by flexing the floor at the point where the control rods penetrated.

Greg's respect for Uther engineering went up a couple of notches. He'd known, intellectually, that they'd achieved space flight without electronic control systems, but he'd never appreciated just how clever they'd been to do that.

All the more reason, he realized, to keep the starbase away from the Fay D-flat Seege.

By squirming so his back fit between the rounded domes, he pulled himself forward a few centimeters at a time. The tanks protested loudly, but he made progress.

When he got to the hatch, he could see that it opened *up,* into the cabin—as a pressure hatch should, of course. He twisted his head to look down—there was a clear passage some twenty meters down to the ground, which was, by now, quite light. He would have to cantilever himself over this shaft, somehow, to get into the hatch. If he could open it.

"Kanti," he whispered, hoping his voice would carry, but not too well. "I've reached the door."

"Greg? Greg, hurry! Bach's getting very nervous. The sun's rising!"

"I'm trying," he replied. He grabbed a cable lever with his left hand, hoping fervently that his weight wouldn't damage it. His right hand could reach the door this way for as long as he could hang on. But there were no external controls, locks, or anything. More in frustration than as a considered act, he simply pushed on the door.

It rose, a little, but felt very heavy. It seemed hopeless to lift it by main strength from this position, but he pushed again—and, out of the corner of his eye, caught one of the nearby cables moving. He grabbed it and pulled experimentally.

The hatch swung up slowly and smoothly with relatively little force. Of course—anything heavy needed in the cabin probably came up this way, and provision had been made for ground crew access.

But they would have had ladders. Hanging onto a cable rod with the left hand, he was able to grasp the hatch rim with his right. With his foot pressing *gently* on the dome of the nearest tank, he eased himself through the opening, got his elbows on the inside of the hatch rim, got his legs free of the crawl space, and pulled his rear end in. Then he hit his head on something swinging over the hatch opening. As his eyes adapted to the illumination level, he recognized a lightweight block and tackle.

Light trickled in from his left—a shaded port in bright sunlight. The in-

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ner door of the airlock was open! In a minute he was able to find the cable reel for the block and tackle and drop the hook through the central shaft down to Kanti and Bach. There was a moment of song while they discussed the logic of who would go up first—but finally Kanti began pulling herself up. He helped as he could, and soon she squirmed in beside him.

They looked at each other, thinking escape. Was Bach taking a chance? No. They would never have time to figure out how to fly this thing if it gave the alarm now. Their only hope was to have the Uther with them—and it knew that.

The cabin was roughly conical on the inside, with the airlock a flat, low cylinder set in the floor. The top of this was apparently configured as the control deck, with an Uther couch and a set of levers within easy reach of it. There were also small black boxes fixed to the deck next to the levers with what looked like push rods running to the levers.

"Kanti, this ship was designed to be flown manually, without electronics. The electromechanical control system is clearly an afterthought. Ask Bach if it can read the labels."

In short order they had identified: "boost liquid little doors this thing opens-adjusts," "artificial updraft direction this thing modifies," "burning slick stuff little doors this thing opens-adjusts," and "wing-level this thing tilts."

On one side of the cabin was what was clearly an electronics rack, with infrared connect windows. There was a battery powered Uther radio—without batteries now, of course. Then he found what was clearly a manual of some kind.

Kanti gave that to Bach, who issued a stream of notes.

"It says it doesn't even know how most of these words are pronounced, let alone what they mean. It sounded out a couple of them, and I don't know what those motes mean either."

Bach issued another stream of notes, flowed up into dominant stature and brought up its gun.

Kanti translated in a trembling voice. "It said 'This vehicle, other guards'—the next mote means 'ranging' I think. Then, 'Up we three fly now or dead you two must be. Killing it regrets, but otherwise dead all three of us will be.'"

Greg was, by now, beyond fear and into deep fatalism. Either he could fly it or not. "Tell him not to panic. I'll think of something, just hold on."

Right, Greg thought. Think of something. Opening the propellant valves manually might just fire the rockets—there had been, he recalled, a similar arrangement on the first human-carrying spacecraft to land on the Moon, for emergencies only, of course. The directional controls, if that's what they were, might let him steer. One of them had two degrees of freedom—pitch and yaw? He thought about the gimbals he had seen, but there wasn't time to trace the levers and cables now.

How much delta-V did they have? The tanks easily occupied 80 percent of the volume of the ship, and hydrogen peroxide was a very dense fuel, though low on exhaust velocity. The

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cured organic membranes and fiberglass rod framing of the ship was obviously very light. Did it have a mass ratio of as much as thirty? That would get them, he thought, beyond escape velocity.

This was designed to attack a space base at Epona's L5 point—it should be capable of escape velocity and then some. If so, it didn't really matter what trajectory they went, as long as he kept it going in the same direction until he'd used all the fuel, or nearly all. East. He'd go east at the rising sun to pick up some of the planet's spin velocity too, just to be sure.

"Shut the airlock door, and brace yourselves. This will be a little rough." If it didn't blow them up immediately. Greg climbed up on the Uther acceleration couch, and lay on it face down. He could reach what he thought was the direction control. He moved it experimentally, worried that the rods in the black boxes might be frozen without power—but no, it moved smoothly. Greg smiled in thanks to the Uther engineer who had anticipated failure of the newfangled electronics.

But he couldn't reach the presumed valve control levers from the couch.

"Kanti, I'll need you and Bach up here to work the propellant valves. It seems clear that all that has to be done, initially anyway, is to push them forward as far as they'll go."

There was an exchange of song.

"Bach says no, humans fly. Greg, I think it's scared crazy."

Great, just great, Greg thought. OK, two valve controls. One for "burning slick stuff" which was probably the hydrocarbon fuel. By itself, that wouldn't move the ship, whereas the peroxide decomposing might.

"OK, we'll turn the hydrocarbon on full first, then add peroxide."

A sudden thud shook the ship. Bach warbled crazily—no translation was necessary.

Greg ignored it and thought. Once they started acceleration, the only way he'd know what real "down" was would be through an external reference. The window had to be open. If he could see both the sun and the horizon and keep them there. . . . His best chance for control would be to accelerate up as fast as possible, giving him a little time to find balance. He moved what he hoped was the gimbal control to what he hoped was dead center.

"Kanti, here's what you have to do," Greg said as calmly as possible. "This couch has straps; whatever happens, I can't be sent flying around the cabin. Strap me in. Then open the window cover, and get up here. Then push *this* lever all the way forward fast, then get over to the other side and push the other one the same way as fast as it will let you and brace yourself. If I'm right, the engines will fire as soon as the propellants mix."

She nodded very seriously. "Got it." She went over to the covered viewport and looked at the cover helplessly. The ship shook again, and Uther song penetrated its hull.

Then an amplified hoot from outside demanded attention. "INSIDE HUMANS, IF TALK NOW—THEN—YOU NOT BE INSTANTLY KILLED."

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He didn't need Bach's hoots to tell him that there was no possibility that the promise would be kept, nor, if it were, would they be allowed to warn others of the fleet.

Greg allowed himself a little smile. "Don't panic. I think they're trying to scare us out. The last thing they want is for this thing to explode in the middle of a thousand other fueled spacecraft. Tell that to Bach."

Kanti sang triplets, then repeated them.

Bach, stopped its panicky warbling, and sang a few chords.

Kanti sang again, then Bach.

"Bach says it will open the window when we're ready. It knows how to work the latch."

"OK. We'll do it this way. Fuel, Window, Peroxide. Get up here and grab the left lever! Push it forward, tell Bach to open the window, then go over and push the other one forward."

Kanti sprang up onto the control deck as if on wings and pushed the indicated lever.

"It won't move!"

Bach warbled insistently—again there was no need for translation. The cacophony outside was increasing. Why wouldn't the lever move? Come on, he told himself, the idiots that made this thing were bright. They had redundancy, they were concerned about hull integrity—safety.

"Check for some kind of safety latch—something mechanical to insure no one opens the valves accidentally. Probably down by the base."

After a too-long five or ten seconds, she said, "Found it, just a little hook. I unlatched it. Push the lever now?"

"Yes!—No! Wait! There'll be a safety hook on the other lever too. Unlatch that first, then open this one."

Kanti bounded over his Uther couch, where he held onto the directional controls with white knuckles. Bach had stopped its panicky warbles—what Kanti was doing was simple enough for it to see and understand, and it was bright enough not to interrupt in the crisis.

Then Kanti was back across the couch again and at the first lever, and looked at him.

He was probably about to be blown to bits, and his life should be passing in front of his eyes, but the thought barely passed through his mind. He was concentrated on *direction*. Try to go straight up, roll to find the sun, lock in and keep it there. He nodded sharply to Kanti. She shoved the lever all the way forward. A sound like a toilet flushing ran through the ship.

"Window!" he yelled. She warbled to Bach as she jumped over to the peroxide lever.

Bach flung open the window shade, and let loose a blast of sound at the Uther face that appeared in it.

Surprising himself, Greg thought he recognized the tone mote for "far, far, far." The Uther in the window vanished, as if pulled by a string. The loudest roar Greg had ever heard let loose as Kanti pushed the peroxide lever forward and fell back with the sudden acceleration.

Up they went. In less time than it took him to think about it, the horizon vanished from Greg's sight. In an instant he realized his control idea

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was wrong. First, keep the horizon level in the window; that was straight up. *Then* worry about the sun and roll. He couldn't be too far off; the pitch control was still near center and the window still showed distant land. He edged the control slightly in the direction *away* from the window and got the horizon again, but tilted.

Inertia helped—the massive ship didn't change direction quickly and his reflexes were easily fast enough. He had to remember that he had time to think and not overcontrol.

Pushing the "roll" control forward rotated the ship counterclockwise. He rolled the window toward the ground, and gingerly pitched until the horizon was level in the port again.

Whoever was watching this was seeing some crazy corkscrews, he thought. But the controls felt very smooth and responsive; the designers had built some inherent stability into this rocket—after that initial tilt, it didn't change directions easily. When he got good at keeping the horizon level, he rolled to find the sun.

The gap between the sun and the horizon had grown significantly already. Soon, the sun would be out of view high, if he kept the horizon. But he would lose his "down" reference if he lost the horizon.

The glare was nearly blinding him; he'd keep the horizon. But what about direction? He looked down. The flight deck was a brilliant green in the bright sunlight.

He didn't have to *see* the sun—he could track the spot of sunlight the sun cast into the cabin! Keep the spot on the floor, in the same place near and left of the window, and they'd be on an eastward vector!

He rolled the spot onto the bulkhead left of the window, then gradually tilted the horizon. The spot of sunlight wobbled along the floor to a point beneath the port as the horizon tilted to just short of vertical.

It wobbled around as he made continual corrections—the steering was getting more sensitive. Also, Greg's arms were getting very heavy.

The ship was getting lighter, of course, as they burned fuel, and acceleration was up.

He tried to think: a mass ratio of, say, thirty with an initial acceleration of something like fifteen meters per second squared, two Eponan gravities? With a little over half the fuel gone, acceleration would double.

"Kanti!"

Groan.

"You have to ease the peroxide lever back. Push yourself up and do it! Now!"

Groan.

How stable were these controls? Could he get up and do it himself? They must be up to three gravities—but he had to.

No, Kanti was crawling over to the lever. She pulled it back, and acceleration eased.

"Pull it back slowly until you're comfortable."

This, he realized, wasn't very efficient. They should be reducing the hydrocarbon too, or soon they would be too fuel rich and waste delta-V.

"Can you go over to the other lever now? Reduce thrust by pulling that one back until it's about the same po-

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sition as the other one. Then keep going back and forth, OK?

"Got it," she answered. Thrust went way down, then started to build back up again. In a minute, Kanti established a routine, going from one lever to another. Acceleration stabilized.

They must have wasted one hell of a lot of fuel, Greg thought. But at more or less constant acceleration, the lever positions at least gave him some idea of how much fuel he had left.

In a tribute to the engineers, the levers stayed where they were unless moved. Greg quickly discovered that he could keep his hands off the directional levers too, except when he needed to make a slight change, and the ride got much smoother.

The sky outside was black now. They had been rising for what, five minutes? It seemed to Greg like an eternity. Keep going, he said to himself—keep it going. Crazily, he noted that, in the confines of the cabin, he and Kanti still stank from the insides of the snail.

When the propellant valve levers had gone about 90 percent of the distance back to where they had started, Greg had Kanti pull them all the way back, peroxide first. Acceleration vanished. Hopefully, they were in orbit, or at least on a trajectory high enough to it to be rescued.

Had he saved enough fuel to manage a powered reentry? Greg hoped he wouldn't have to find out. Of course, better that than running out of whatever air they had sealed in with them. What the Uther provision of life support systems was, he had no idea—but maybe, just maybe, they were designed to operate without power. He was certainly breathing OK for now.

A tortured hoot reminded him that they had an Uther on board. Kanti sang at it, and it sang back.

"It's OK, just stunned," she said. "'Space, this blackness, is?' it asks."

"Yes," Greg replied. "Space, this blackness is."

"We've got company!" Kanti announced. "Come over here!"

Greg, belatedly, released himself from the couch and pushed himself over to the port. Not a kilometer away was a human shuttle, growing closer. *Their launch,* Greg thought, *must have given the cyberservants quite a surprise—and their human masters nothing less than a shock once their lift-off plume revealed the rest of the disguised fleet.*

Bach toned several chords. Kanti translated. "Fay D-flat Seege plans other humans now know. Spacecraft Fay D-flat Seege not now launch. Too late that action would be."

An idiot that Uther was not, Greg thought. "If they wanted any chance at the station at all, Fay D-flat Seege's best move would be to launch immediately. But I think that would still be too late—the base should have effective countermeasures together in hours."

"Effective? You mean to kill all the attackers?"

"I wouldn't think so. I'm not sure what they'd come up with, but it might be that our replicators are already turning out hundreds of tiny robot tug spacecraft that would rendezvous with the Fay D-flat Seege ships and push them back toward

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Epona. Knute won't kill anyone if he doesn't have to."

Kanti frowned. "Not so simple. The Fay D-flat Seege would be humiliated—other flocks would do the killing."

Greg shook his head. "Maybe they'll work out some kind of face-saving compromise."

Kanti didn't look hopeful. "Maybe," she said. "Meanwhile, I think it's going to be a disaster for human-Uther relations down there." Then she translated for Bach.

The Uther hooted, then spoke in triads.

Kanti laughed herself. "I guess I don't know everything. What Bach said was 'Fay D-flat Seege ship you humans scavenge. Much respect outside Fay D-flat Seege you humans win now.' Now that it said that, I can see it. But that creates another whole set of relationship questions, doesn't it?"

Greg nodded. Be careful of what you wish for; you may get it. "Yes, it will take some time for all the ramifications of our little adventure to work themselves out."

Bach glided over to the viewport with a ripple of its forewings. Then it took, from its ventral pouch, a small transparent box with rounded corners. In that, on a bed of what looked to be packed dirt, were a few flecks of green, gold, and crimson, and with its roots wrapped around a small rock, a tiny pagoda plant.

Kanti looked at Greg. There was no spontaneous outburst, as there might have been from the child he knew only two days ago. Instead, he met the eyes of a woman who had learned to deal with consequences. Her voice was quiet. "Fair play, I suppose. It's going to be hard on Mom. At least it looks like we'll get to the starbase before her. We can try to explain."

Greg nodded; it would be hard on Kanti, too. He wished he had a human comm set.

The blue white orb of Epona turned slowly below them as the human rescue spacecraft matched their course. As if by common consent, the three of them savored a few moments of silence before the universe of events devoured them again.

Bach spoke. The three tone groups it uttered were, as usual, devoid of emotion in human terms, but Kanti whispered the translation: "Too heavy a carcass this Uther may try to carry, but into that carcass my teeth are forever sunk. My wings, providence must lift."

That, Greg Konstantis thought, *made two of us.* ■

What we want is to see the child in pursuit of knowledge, and not knowledge in pursuit of the child.

—George Bernard Shaw

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Epona may not really exist, but it's certainly a good example of how scientific principles can be used to imagine worlds and beings that might exist!

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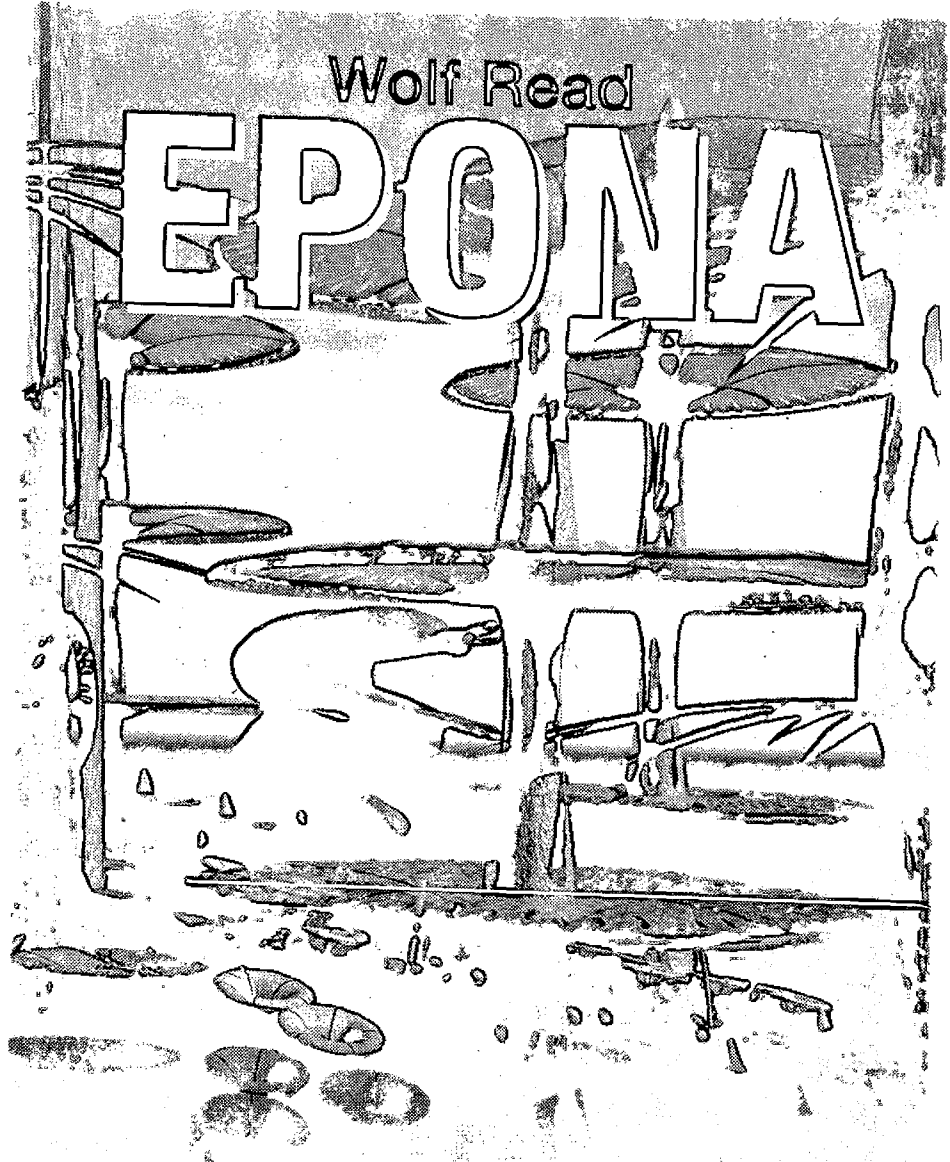

Figure One: A computer generated Eponan landscape offering a view from one of Epona's warm temperate regions. The umbrella leafed "plants" are pagoda trees, and are grouped in the phylum Myophyta.

Illustration by Steven Hanly

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Epona is a strikingly detailed fictional alien world. How detailed? *Very.* A Webster's-sized dictionary might be enough to contain all the textual information amassed on Epona; and this grossly ignores the hundreds of Eponan art pieces detailing the world, from ink illustrations and paintings, to computer-generated renderings and animations, to sculptures. Quoting Larry Niven, who had a chance to view an Eponan interactive computer demo, "I have never seen a playground this size."

The genesis of Epona came from a project created by members of *Contact,* a nonprofit educational organization with roots in science fiction (an article on *Contact* appears in the January 1992 issue of *Analog*). This experiment is called Cultures of the Imagination, or COTI. People participating in COTI are divided into two groups. One group creates an alien world with a sophont while isolated from the second group, which builds human history to the point of starflight. Development proceeds for three days during the annual *Contact* conference, and at the end, a first contact is simulated between the two isolated groups. Lots of fun.

After taking part in a COTI session, people sometimes mentioned that three days was not enough time to significantly develop an alien world and culture. In response, at Contact X, it was decided to build a world over three years. A regular newsletter for the Epona project was created, inviting *Contact* participants to join in the long-term development of an alien world. Many people, such as myself, responded, including artists, biologists, chemists, astronomers, anthropologists, and science fiction writers. The amount and variety of Eponan ideas, their interconnectedness, and the solid scientific detail supporting the framework was entirely unexpected.

EPONA'S FAMILY OF WORLDS

Epona is the third world of nine which circle the star Taranis, originally 82 Eridani. Taranis is a yellow dwarf (G5 V main-sequence) star that is roughly 5 billion years old. As its original name implies, the star resides in the constellation Eridanis, and currently drifts in its galactic orbit some 21 light-years from Sol. Names of worlds follow a Gaelic tradition.

The four inner planets of Taranis, including Epona, are terrestrial in nature, being small, ranging from 0.1 to 2.0 Earth masses in size, and having average densities within the range of rock, from 3.8-6.4 g/cm^3. The inner two worlds, Belenos and Grannos respectively, are similar to Mercury, with small bodies, high densities and little in the way of atmospheres. The large chunks of rock are tidally locked to Taranis, and Grannos's long-ago atmosphere has been frozen into carbon dioxide ice on its night side. Epona follows, with a mass of 0.55 Earth's, an oxygenated atmosphere that averages 0.577 bar at the surface, continents of silicate rock, temperate climate and seas of water. The fourth world, Sucellus, with a high density of 6.4 and mass of 2.0 is a sizable terrestrial world covered in

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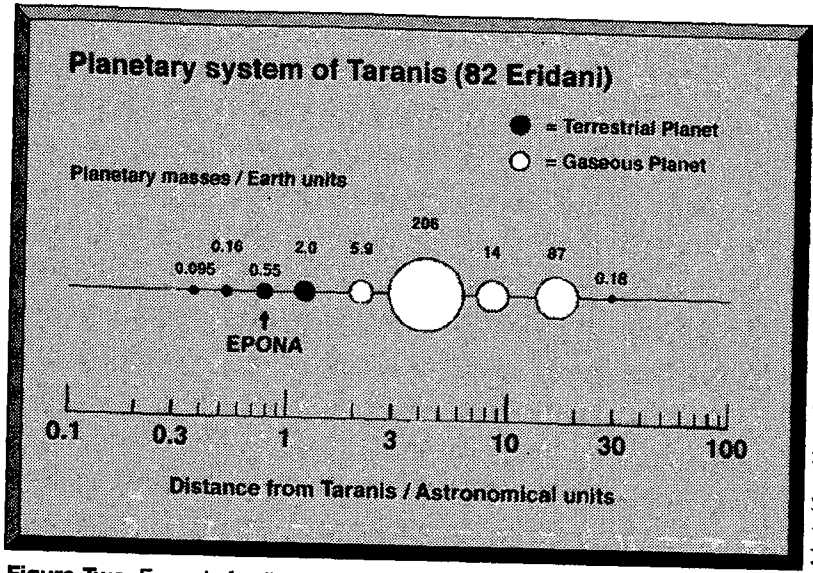

Adapted from Martyn Fogg

Figure Two: Epona's family of worlds. Unlike the Earth, which holds the number one spot in size for terrestrial worlds in the Solar System, Epona is only the second largest rocky planet in the Taranis system, and, only massing about half that of the Earth, Epona has experienced significant internal cooling. As explained in the text, failure of the carbonate silicate cycle due to Epona's solidifying mantle has significantly affected the climate, and subsequently biological evolution.

a deep ocean and insulated by a carbon dioxide atmosphere of roughly four bars.

The next four planets are a family of gaseous giants, with huge masses, from 5.9 to 206 Earth's, and light densities, all sitting around 0.7-2.4 g/cm^3. The fifth world, Rosmerta, is the smallest of the family, a mini gas giant with a viciously hot world-encircling ocean being sustained under an equally challenging atmosphere that exceeds 1,000 bars in pressure. The small gas giant is followed by the largest, Borvo. Borvo is 65% the mass of Jupiter and is similar in nature, producing a powerful magnetic field, tightly holding a vast array of moons and presenting a surface of seething storms. Bormo, world number seven, is similar to Uranus, even possessing a strong axial inclination of 73 degrees. Bormanus, the eighth planet from Taranis, is similar to Saturn in density and mass. This icy-ringed world follows the most elliptical path of Epona's sister planets, maintaining a mean eccentricity of 0.16.

The final world, Sirona, is Tritonian, being comprised of ices, though it is more massive than Mars. Occasional cryovulcanism maintains a thin

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atmosphere of nitrogen, methane and hydrogen.

EPONA'S GEOLOGY

Epona accreted a similar distance from Taranis as the Earth did the Sun, so the composition of the two worlds is quite alike. Epona has a lower abundance of heavy elements, accounting for a lower density. During the first 3.3 billion years of existence, Epona possessed a liquid iron-nickel core, a convective mantle and shifting lithospheric plates.

Epona's tectonic activity did not last as long as it has on the Earth. Being a smaller world, Epona has a higher surface-to-volume ratio than the Earth, and thus has had its store of internal heat dissipated at a significantly faster rate. Nearly two billion years ago, Epona's tectonism began to slow, and later froze up completely as the lithosphere continued thickening. Many types of mountain building stopped, and continental masses simply weathered and eroded away.

Habitability: Maintained by a Cycle

Highly weathered continents are OK as far as Epona's biome is concerned, but breakdown of tectonism has one major side effect for life. Epona's dead geology severs the important carbonate-silicate cycle.

In a "normal" state of affairs, as on Earth, carbon dioxide in the atmosphere combines with water to produce carbonic acid. This carbonic acid falls as rainwater and breaks down continental rock—a major feature of weathering. Bicarbonate ions, HCO_3 (-), created by the chemical weathering, wash down the streams and into the oceans. In the sea, these ions reach saturation and precipitate from the ocean as carbonate ions, CO_3 (2-), and accumulate in vast seafloor deposits, or are used by some animals to create hard shells.

Once converted to rock, the carbon atoms cannot escape, except by subduction. As the seafloor is pushed underneath the world's numerous lithospheric plates, heating eventually releases the carbon as a gas again, which finds its way back into the world's atmosphere via volcanoes and sea-floor spreading margins, where the cycle starts anew. . . .

Except when subduction and volcanism fail, as with modern Epona, dropping carbon dioxide production to bare minimum as outgassing ceases. Lose one tie in a loop, and the entire system crashes, so to speak. No more CO_2 for Epona.

What's in a Broken Tectonic Cycle?

All the world's carbon dioxide will be lost when tectonism fails. How does this affect life? Very simply, and very profoundly. The carbon dioxide in the atmosphere provides Epona a buffer against a changing amount of sunlight from Taranis. See it this way: As a main sequence star ages, it becomes *brighter*. So, early out, Epona received less sunlight from Taranis than at present. With less Taranan flux, Epona should have been frozen, right? Nope.

The amount of carbon dioxide taken from the atmosphere depends on

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the amount of water that is being evaporated from the seas, because one needs water to make carbonic acid. An early Epona receiving less sunlight will have less evaporation, which means less rainfall. Less rainfall means more CO_2 molecules left in the atmosphere and we all know what more CO_2 means: greenhouse effect. A good quantity of CO_2 equals a warm and equitable habitat for life. As Taranis grew brighter with time, the amount of evaporation on Epona increased, making more rainfall and taking greater quantities of CO_2 from Epona's atmosphere. With less greenhouse effect over time, the climate maintained fairly even in temperature—until a few eons ago.

Kill tectonism, and the production of carbon dioxide stops entirely. In a few tens of millions of years, much of the available CO_2 becomes chemically bound to Epona's crust. Freeze time.

At the beginning of the new low carbon dioxide era for Epona, some 1.7 billion years ago, her previously equitable climate eroded into the cold clasp of a prolonged ice age—*despite* Taranis's increasing luminosity. For the land-based biomes, and a little less so the aquatic realm, the sustained ice age proved a significant challenge, causing vast extinctions. The very limited CO_2 during this period was not enough to sustain photosynthesis very well for terrestrial plants, and they died. Herbivores quickly followed the vegetation's death march, and the carnivores consequently suffered. In the oceans, photosynthetic organisms were able to survive by using bicarbonate as their carbon source, sustaining an aquatic biome, albeit a cold one.

A New Geologic Cycle Begun

Epona's internal heat has not completely dissipated. Enough warmth has remained to produce residual bouts of terminal volcanism every one hundred million years or so, give or take an epoch or two. These huge plagues of eruptive activity release vast quantities of CO_2 back into the atmosphere, providing a new greenhouse effect and an initially abundant carbon source for photosynthesizing life.

Under this warming trend, the ice retreats, and land areas previously covered in glacial ice become exposed for repatriation by life. The volcanism spike is short-lived, say a few million years, and the warm periods only last ten to twenty million years. Long enough for terrestrial life to radiate and become established, only to be choked from the continents as the CO_2 steadily drops, allowing Epona to ice over yet again.

Epona has experienced at least twenty of these glacial events in the last 1.7 billion years, and is at a warm period's end right now, in our modern era. Much new aerial, terrestrial and aquatic life has evolved during this most recent ten million years of equitable clime.

EPONA'S BIOLOGY

Much is known about the Tir fo Thuinn region of Epona, an ancient, flat, tectonically dead continental craton that has been weathered by rainfall and glacial action for at least one

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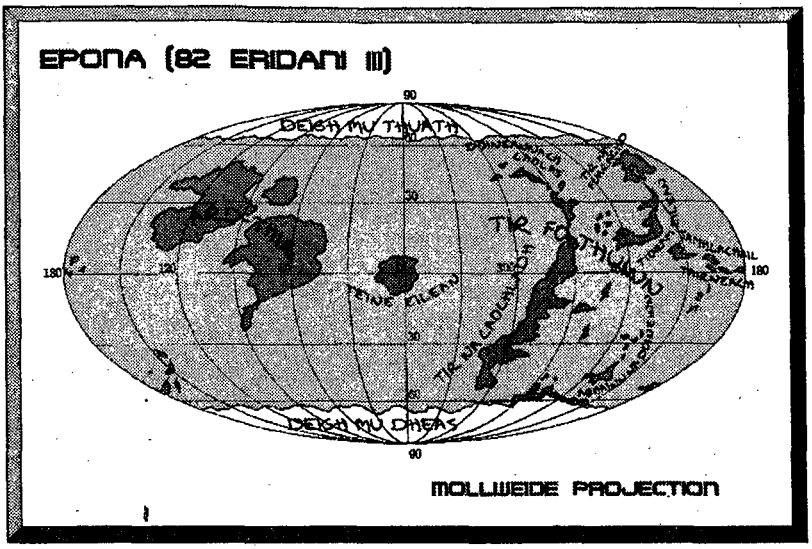

Adapted from Martyn Fogg

Figure Three: Modern Epona. Many of the names for the large landforms follow a Gaelic tradition. Tir fo Thuinn, meaning "land under the waves" is also called the Sunken Continent. Tiene Eilean (Fire Island) is the most recent addition to Epona's landmasses, having been produced by Epona's latest convective bulging (not unlike the Tharsis region on Mars) and sudden bout of atmosphere warming volcanics beginning some ten million years ago. Large plumes of ejecta still billow from Tiene Eilean's massive 10 km high volcanoes about every century or so.

billion years. Due to space constraints, we'll only look at the primary microfauna, megafauna and megaflora of Tir fo Thuinn. A very detailed aquatic realm, one terrestrial animal class, and at least two kingdoms of photosynthetic metazoans are being left out. The organisms described below are a world-wide presence, however, so Tir fo Thuinn provides a good opportunity to show some of what lives in the Eponan countryside.

Kingdom Archaeanimalia

Kingdom Archaeanimalia contains those Eponan animals possessing a somewhat Earth-like morphology and physiology, namely the silacopods, springcrocs and the flectocellids. Nevertheless, do not let these words fool you into thinking that mammals and reptiles are running around on the surface of Epona. Quite the contrary. Though the archaeanimalia have some similarities to Earth critters, such as internal mineralized skeletons in the case of springcrocs and external skeletons in the silacopods, there are no vertebrates, and members of the existing archaeanimalia classes are

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quite different from anything existing on the Earth.

Class Silacopoda

Silacopods are a class of segmented organisms ranging from ant to gazelle in height—Epona's lighter gravity seems to be aiding the larger forms. Silacopod bodies are supported and protected by an exoskeleton of silicon dioxide, basically glass. Respiring through solid silica is difficult, so the stem species had a pair of breathing stalks, which resemble antennae, on each of its ten segments. Being structured somewhat like a centipede, the basal species also had a pair of legs attached to each segment.

Figure Four: A nailbug, dread of the bare-footed walker. The tail, which is actually the reproductive organ, is shaped like the creature's head, a mimicry which further aids the nailbug from predators by causing confusion. Not all carnivores are deterred by the spines and tricked by the tail, however, and one line of silacopod predators smashes the nailbug's hard shells with limbs modified into heavy clubs.

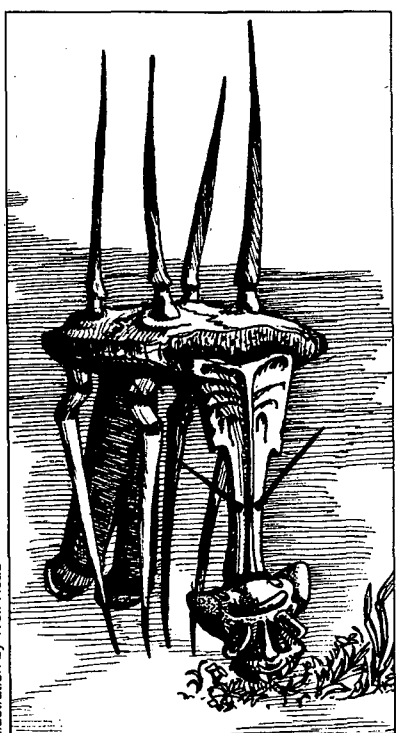

Illustration by Wolf Read

All known silacopod species have evolved from the basal centipede form and are modifications of it: usually having fused many of the segments into three significant body parts and reducing the legs to four, two on some occasions. Thus, many of the critters appear to have an inordinate amount of antennae on each major segment, when in reality, these organs aid in respiration. Modification to the numerous limbs is common, with typical products being the creation of liquid-filled spines for sensing sound and grasping organs like those used by some arachnids and crustaceans on the Earth.

Silacopods have filled a variety of ecological positions throughout the terrestrial reaches of Epona, though the greatest variety of critters are found in the tropics of Tir fo Thuinn, and on an isolated chain of islands found far east of the continent's mainland, called the Chirping Chain. Indeed, the Chirping Chain holds some of the most exotic species, including nailbugs, a herbiv-

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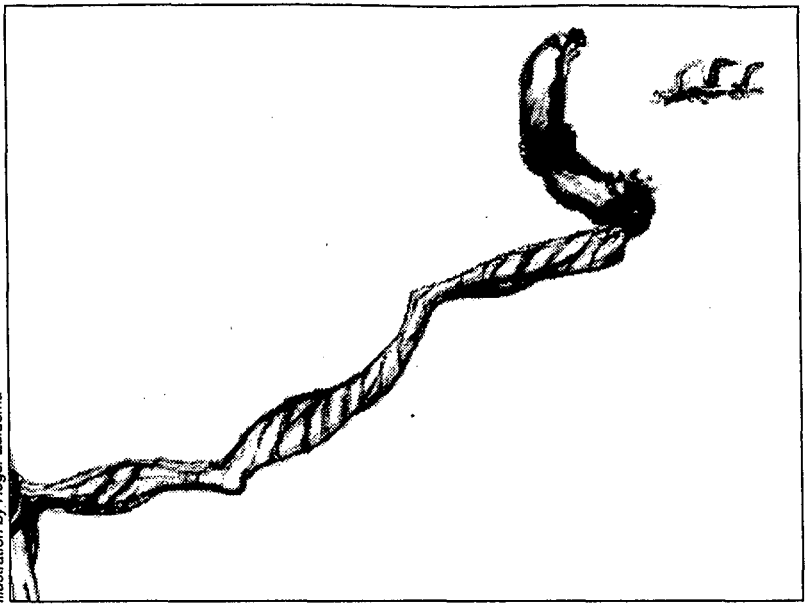

Illustration by Roger Zuidema

Figure Five: The snapping flower commonly hangs from Epona's vegetation, waiting for small flying critters to fly past, often avian pentapods. Like a chameleon firing its tongue, the snapping flower catapults its powerful clam-like jaws on a long, single leg, quickly plucking items from the air. Digestion is slow, with fluids filling the cavity made by the hard shells, not too unlike a Venus's fly-trap.

orous lineage that forms vast, ground-covering herds. Tall, sharp siliceous spines protrude from the back, making for a painful bed of nails for any soft-footed creature to walk upon.

Class Gastrognatha

The springcrocs are, well, weird. Looking somewhat like a single-legged clam in their basic form, one would hardly guess that they rate amongst the most vicious predators on Epona. All springcrocs acquire food by hiding and then pouncing upon a hapless prey item that has wandered near. The leap is achieved by using the single, flexible and well-muscled leg. Prey are usually killed with the springcroc's clam-like jaws, though some use poison.

Many of the springcroc species live only in swamps and marshes, where they tend to hide under shallow water in wait for a prey item to come for a drink or wander near. Once captured, the meal is taken underwater for slow consumption, with some of the chemical reactions during digestion providing oxygen for the springcroc as it

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Illustration by Wolf Read

Figure Six: The entire mantel of the giant snail is capable of digestion, though some cells are better at it than others. Even if one were to grasp the snail's eyestalks, the cells would convert and one would begin feeling a tickling as their hand slowly became consumed. Aside from their usual transfer of reproductive cells, giant snails can reproduce parthenogenically: That is, a small piece torn off of the parent body, if given nurturing moist conditions, will quickly grow a shell, small eyestalks and begin its life as a new snail.

feasts. Digestion is carried out inside the two shell halves, a region which serves as the creature's stomach.

Class Gastrognatha has derived significantly, and contains species occupying a wide range of niches. One of the most abundant clades is the snapping flower, which oftentimes hang from pagodas on their long, thin legs, with their clamshell mouths wide open. Fleshy growths in the mouth mimic brightly colored archaeplants, tricking would-be herbivores into becoming a meal for the little springcroc.

Class Flectocellia

This class is best represented by the giant snail, *Eponapulmonata giganticus,* which has a bowl-shaped shell reaching two meters in radius that was used for a variety of purposes by primitive uthers (Epona's sophonts). A thick, leathery mantel, made of multipurpose cells, acts as foot, mouth and digestive organ. It sprouts 24 sensor stalks around its rim.

E. giganticus's primitive distributed nervous system can learn food-seeking behavior with a capacity that increases with age and size. When feeding, *E. giganticus* glides over any organic matter, mashes it between its foot's grooves, and forces it up into a digestive/pulmonatory cavity.

For reproduction, *E. giganticus* drops reproductive cells onto the ground, where they encyst and lie

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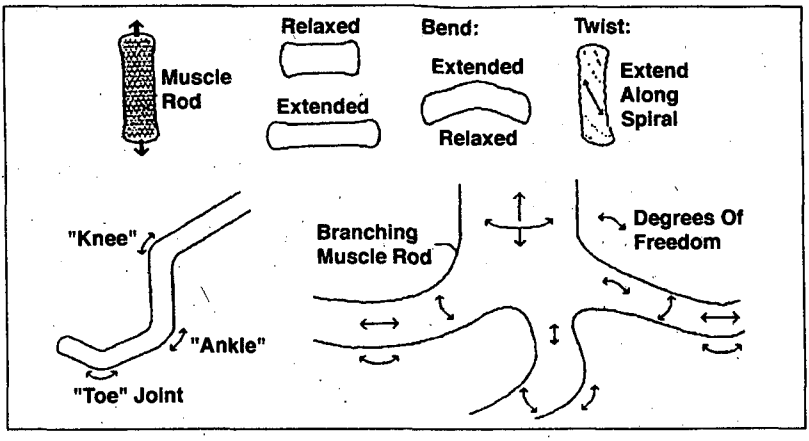

Modified from Paul Birch

Figure Seven: Extensile muscles work by extending, as opposed to the contracting muscles of Earth fauna. Aside from offering mobility to the organism, extensile muscles also act as the entire skeleton, giving the animals a strong degree of flexibility. All organisms in Kingdom Myoskeleta have this soft dual muscle-skeleton. Even Epona's primary "plants," called pagoda trees, have extensile muscles, albeit in primitive form.

dormant until a passing *E. giganticus* picks them up and "wakens" them by dissolving the protein coat with its digestive fluid. The fertilized cells are then dropped by the parent. If the new cells are ejected in moist areas, they form bloblike *E. giganticus* larva that grow tiny shells after a few hundred divisions. Only one out of a trillion grows as big as a cup each year.

Kingdom Myoskeleta

The myoskeletal kingdom consists of organisms that do not possess mineralized skeletons. Instead, their bodies are supported by continuous lengths of osmotic muscle called extensile muscle rods, a combination skeleton-muscle which makes the organisms very flexible. These muscle rods can extend forward and backward, as well as twist through differential activation of muscle cells. Joints are not needed, for they can be created "on the fly" by animating the proper cell groups. The basic body plan built around the osmotic muscle skeleton consists of a barrel-like midsection with five muscle-rod limbs protruding from either end. The tips of the five limbs are then further divided into three smaller digits. What can such a simple body plan accomplish? A surprising amount.

The kingdom is broken down into two phyla, the myophyta, which consists of photosynthetic organisms that reside in plantlike niches on Epona, and the pentapoda, which has produced a host of animals highly derived from the basic body plan described above.

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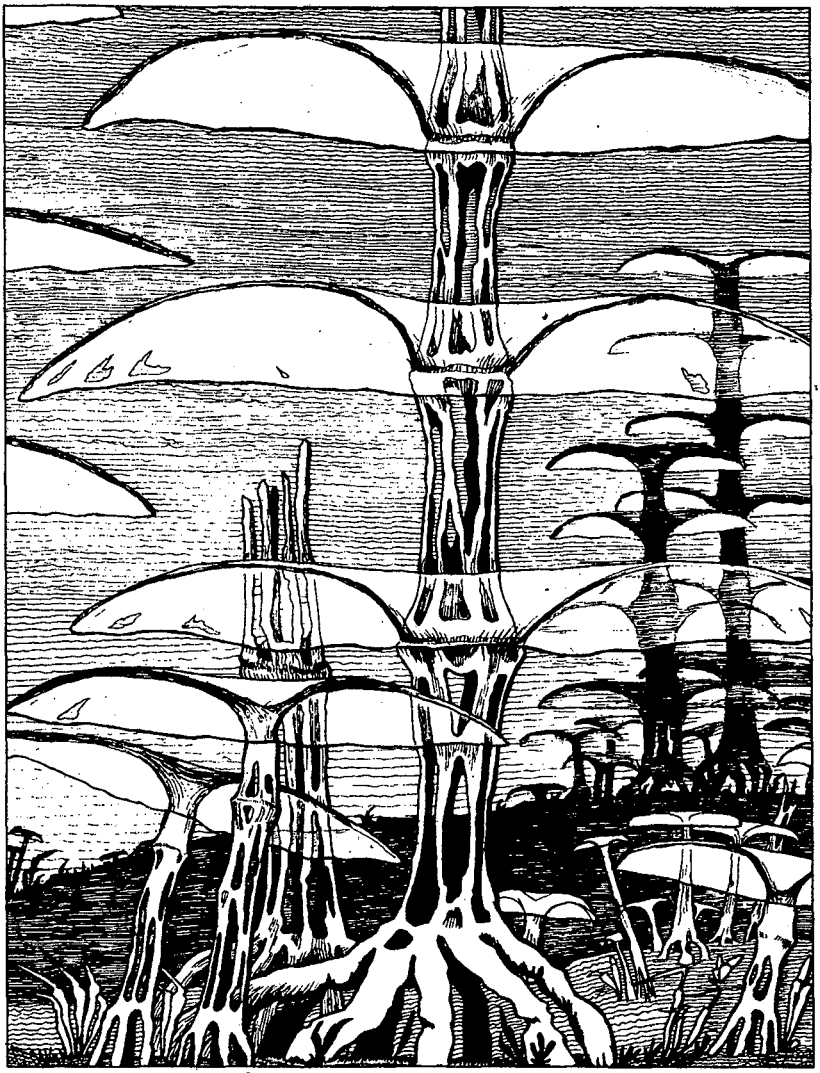

Illustration by Wolf Read

Figure Eight: Variants of the simple pagoda form depicted here can be found all over Epona, though the greatest diversity exists on the Sunken Continent. A number of tropical pagoda species are able to achieve heights similar to Earth trees, while some ground covering species have leaf diameters less than a centimeter. A subgroup called neopagodas has developed a branching method of growth with some trees making beautiful palmate fractal growth patterns.

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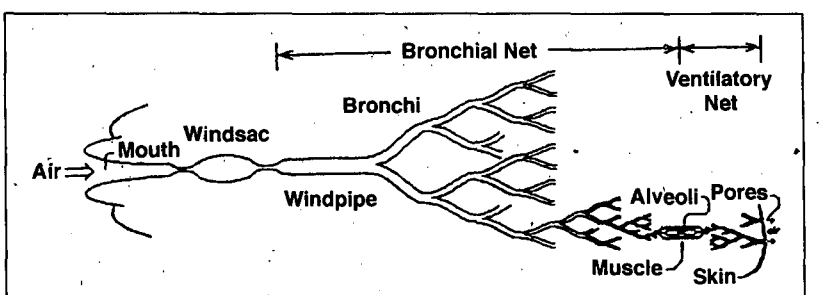
Phylum Myophyta

These photosynthetic organisms, which have evolved from a tiered seaweed, have a very simple form: The previously mentioned barrel is often carried upright, like the trunk of a tree, and the five limbs on one end are sunk into the ground, like roots. At the top of the barrel, the other five limbs have evolved into a large umbrella leaf, so that a single tiered member of this phylum looks somewhat like an oversized mushroom. Five to fifteen spines, derived from the tridactyl nature of the muscle rod limbs, support the leaf, like the arms of said umbrella.

This "plant" form, known as the pagoda tree, is not restricted to one tier. A new barrel and associated leaf can be cloned from a growth bud that exists in the center of the leaf, quickly adding another level. Growth can continue, carrying pagodas to great height. Some myophytes are capable of branching via a polyembryonic method, effectively multiple cloning, though this tends to be simple and is usually carried out in twos, threes, or fives. Though the branching forms share many features with the pagodas, they are not the same, and are called neopagodas.

There is no wood on Epona. The carbon dioxide required for the wood-making process was not available for the pagoda's tiered seaweed ancestors, and the terrestrial myophytes have maintained this ancient carbon-conserving trait. Pagoda stems are held rigid by the osmotic pressure in the extensile muscle cells. This osmotic muscle characteristic gives the pagoda animal-like freedoms. Trunks are very mobile, and they easily track the sun. Tendrils and stems can wrap around a support while one is watching. As a storm nears, pagodas can detect the dropping atmospheric pressure, and lift their leaves up or drop

Figure Nine: The pentapod respiratory system is one way, with air coming through the mouth, and waste gases being expelled through pores in the skin. With this unidirectional airflow, pentapods have a much simpler organ system than Earth vertebrates, as they do not require lungs. The muscles operating the windsack also drive the circulatory system, further simplifying pentapod internal anatomy.



Modified from Paul Birch

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them down (like skirts?!) in an effort to protect the large photosynthetic structures from high winds. A natural and striking barometer! Occasionally pagodas will shrug off an unwanted visitor, like an avian myoskeletal critter who's landed on the myophyte for a hearty meal.

Strongly cold climes and pagodas are usually not a successful combination. Having no bark for protection, the winters kill myophytes off by the billions, whole forests decimated by a single hard freeze. However, Epona has a very thin atmosphere, and even in the tropics at sea level the temperatures tend to drop toward freezing during the night. To combat this problem, pagodas produce various alcohols as antifreeze. Be careful with your campfires.

Silacopods like to eat pagodas, as do myoskeletal animals. Pagodas, in most instances, can't run away. Disliking growing holes in their leaves, pagodas have established a defense routine similar to Earth flora: chemical warfare. Silacopods aren't the only reason for a

Figure Ten: Ceretridons are a diverse group, with many assuming a pagodivorous roll. Being nearly four meters tall, the twintails depicted here feed from large pagoda trees, and perform saltatory north-south migrations in vast herds, responding to the sharp seasons of the Sunken Continent's southern extremes. The herds are thought to offer protection for the single springtime young born to each individual.

Illustration by Wolf Read

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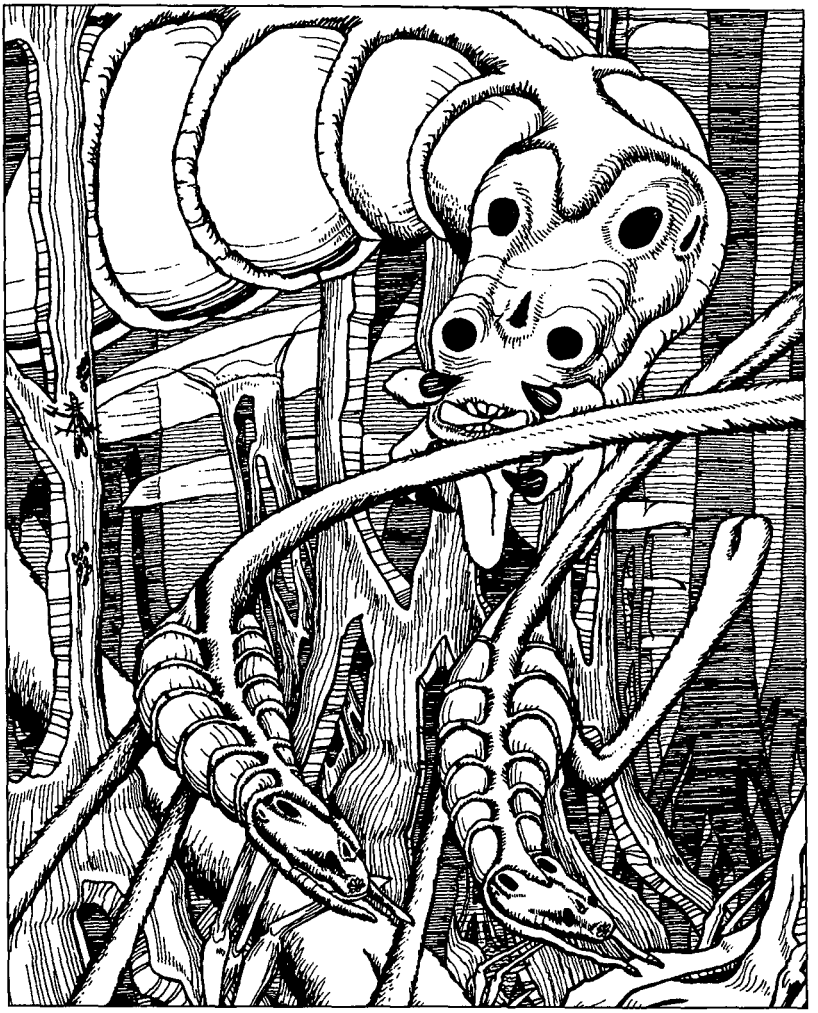

Illustration by Wolf Read

Figure Eleven: A swiftgrasper pursuing two rodent-sized pagoda runners. In parallel to Earth mammals, many ceretridon lineages have developed teeth specialized to their task of survival, probably due to their very conserved morphology. The swiftgrasper has two long, sharp teeth that it uses to impale prey snatched up by its swift mouthpart limbs. The lesser teeth are used to masticate an opening in the skin of its victim, where the internal fluids and organs are sucked through. Lacking true jaws, many predatory ceretridontids have a difficult time eating the tough musculature of their prey.

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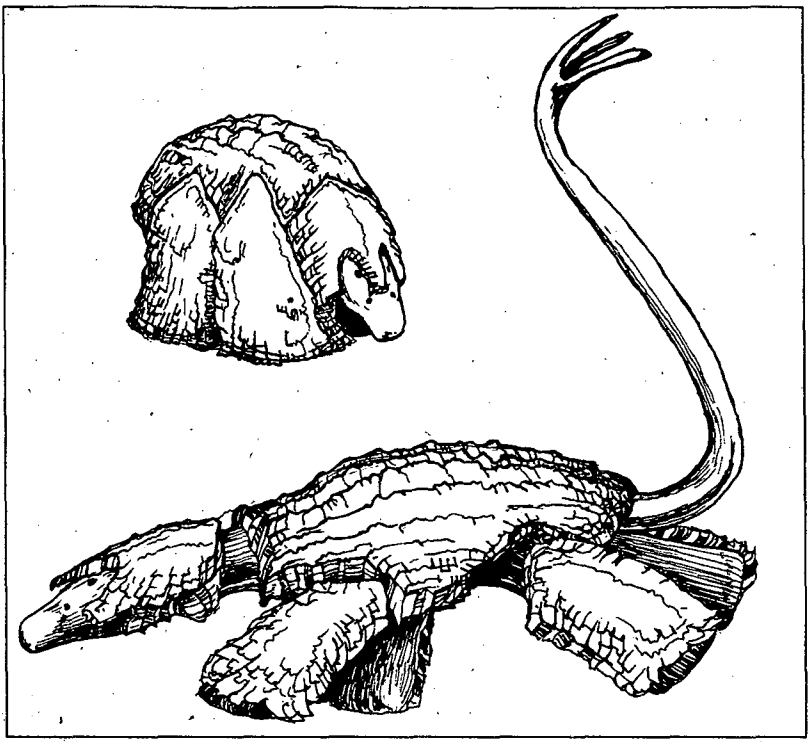

Illustration by Wolf Read

Figure Twelve: The small pet rock is a member of the rare quadrupedal ceretridons. The "tail" is actually the rear, or third, leg on more typical ceretridons. In the case of the pet rock, the limb is used for holding its silacopod prey for consumption. Often, the pseudo-tail is held underneath the animal and cannot be seen from above.

poison defense, for pagodas also have each other. Carbon dioxide necessary for photosynthesis is rarefied even on modern Epona, and pagodas have very large leaves to absorb enough of the life-sustaining gas. Those dome leaves require much space. To create room, the myophytes diligently spend energy making pagodacides to keep near relatives away. Toxin differentiation is so detailed, in fact, that it is the most effective characteristic to use when identifying species, since many pagodas look quite alike morphologically.

Phylum Pentapoda

In pentapods, the basic myoskeletal barrel contains all the vital organs, including the brain (housed in a region of collagenized muscle rod [basically tendon]), and the sensory apparatus, which consists of four eyes, two ears,

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and a third ear located on top of the head that serves as a sonar sender/receiver.

The barrel also houses the respiratory organ, a chamber created by a sheath of muscle rod, forming a hoop-like structure. Two lesser rings of muscle rod sit at either end. Air enters through the mouth, and the muscles sequentially pump it into a network of self-similarly branching bronchi. Upon reaching the lowest level of branching, the alveoli, oxygen is absorbed directly into the muscle (and any aerobic organs) from the airstream. At the same level, carbon dioxide and water are expelled, being carried through a number of tributary paths before being "exhaled" from pores in the skin.

Reproduction is achieved by an exchange of spoor through the mouths of two individuals. The spoor travel to the back of the respiratory pump, where they fertilize a tiny bud. Since individual pentapods have both spoor-producing and bud-producing capability, both participants will get pregnant (no gender roles here), a sort of hermaphroditism. The embryos develop in the budding zone at the back of the respiratory pump, remaining attached to the cavity wall. Birthing is achieved by coughing up the newborn before it becomes too large and obstructs breathing. Since pentapods do carry an entire complement of reproductive organs, they can reproduce parthenogenically, though this only happens rarely, when the organism is under great stress.

The pentapod phylum has produced at least two well-known major groups on Epona, the ceretridons and avians. In a several-million-year radiation similar to the Earth's Paleocene Era, both groups have diversified significantly in the past ten million years, and contain many species.

Class Ceretridonta

The pentapod's simple form has been modified significantly in the ceretridons. The barrel has elongated and grown larger, housing a massive digestive system, and has become fenestrated to reduce weight. A head-like structure exists at the front end of the barrel, though it houses only the sensory organs—the brain is still deep within the original barrel. The sonar ear is practically nonexistent, for it has atrophied in favor of eyesight. All ceretridons utilize their four eyes, with many having a pair aimed forward for binocular vision and a pair aimed upward to spot aerial predators. At the front of the head is a simple mouth that has four to twelve conical, chitinous teeth and a single tongue. The teeth represent the finger terminations on what would otherwise be four of the standard five pentapod arms originating from the front of the barrel. The tongue is the fifth limb. Five other limbs originate from the back end of the barrel. Two arms are carried forward, often inside the body, so that they protrude from the sides of the head, and are used for grasping. The other three limbs trail behind and are the animal's legs, hence the "tridon" in ceretridon. However, there are thousands of species of ceretridontid,

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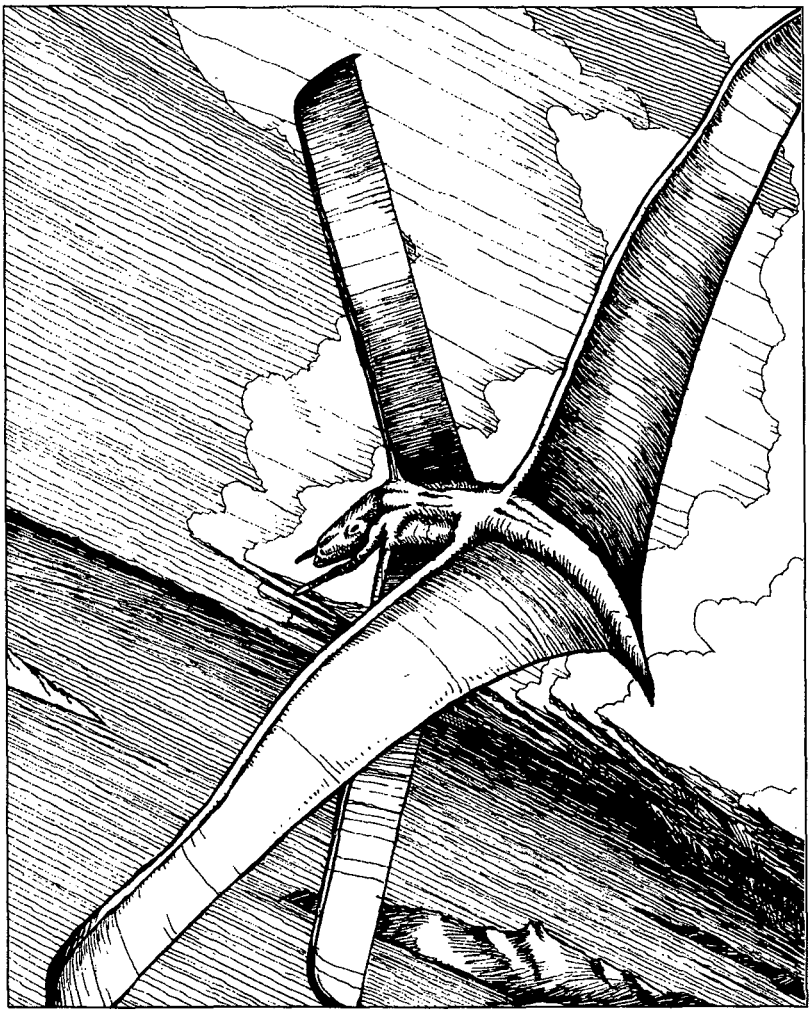

Illustration by Wolf Read

Figure Thirteen: A large predatory avian banks from an incoming thunderstorm. Avians, often feeding on terrestrial pentapods, are the driving force behind the ceretridon's extra two upward-facing eyes. Swift and very strong, avians prove remarkably lethal to any animal caught unawares, often using sharp tipped "talons" of chitin on the tips of their mouthpart limbs as spears. Despite Epona's thin atmosphere, soaring avians such as the one depicted are efficient flyers, often able to glide for hours on end, silently seeking food from altitudes reaching into the hundreds, and even thousands, of meters.

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Illustration by Wolf Read

Figure Fourteen: *Eponas utherensis*, or the uther, is one of Epona's most recent species, as well as her one technophilic sentient. The mouthpart limbs serve as hands (here fisted), and normally are carried backwards while the creature is in flight. Even among the advanced uther cultures, human-like clothing is unheard of, for the cloth would block the creature's skin-expelled waste gases. Some cultures, however, wear loose "nets" around their body from which they hang tools and/or decorative items.

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and many locomotory patterns have evolved among them: monopedal, bipedal, tripedal, and even quadrupedal and pentapedal (using the "arms" by the head). The class has also produced herbivores (actually pagodivores), carnivores, scavengers, and parasites along with the different leg numbers.

Pagodivorous ceretridons have to tolerate many toxins in their lives. Most ceretridons, in fact, are only capable of consuming one, or a few, toxins, so the pagodivores tend to be quite specialized, seeking a specific type of pagoda, usually identifying it through taste. Many pagoda eaters store the toxins they consume as a defense against predators, wearing garish colors and patterns as a warning to any lurking carnivores. With their toxin defense, most pagodivores are solitary, or form very small groups. However, a number of migratory herding species do exist in the temperate climes, where their food pagodas die back into the warm temperate reaches every winter. A common herbivore is the twintail, which hops around Eponan forests on a single rear leg, while the two forelegs typical of a tripedal ceretridon are carried over the back and held horizontally as counterbalances against the weight of the body up front.

Because of their prey's inherent toxicity, many carnivores also tend to specialize, feeding solely on one, or a few, species of pagodivores. Carnivores also tend to be brightly colored and patterned, features for mate selection not too unusual for an animal group with exceptional eyesight. Some carnivores have all four eyes facing forward, establishing a very acute depth perception in combination with their color vision. Carnivore mouth part limbs tend to be very specialized, many having chitinous talons on their fingertips, an aid in prey acquisition. The coyote-sized swift-grasper is an example, having deeply taloned arms held at the sides of the head, ready to snatch prey with a mantis shrimplike speed.

Silacivorous ceretridontids face similar toxin problems, for the silacopods use pagoda toxins for defense. These small ceretridons have the largest teeth relative to body size among their kind, a requirement for crushing the hard siliceous shells of their food. The teeth wear down quickly, and are perennially growing to compensate for the loss of material. A unique example of silacivore is the "pet rock." This little ceretridontid has developed a rough-looking armor from the hair typical of its kind in a way similar to armadillo of Earth. The armor is perforated, a necessity considering the one-way air exchange of the pentapod respiratory system, yet is quite strong, giving the pet rock much protection against predators. The shelled silacivores are sometimes mistaken for stones when they are clamped up, hence their name.

Class Aviana

Avians are similar to the ceretridons in construction, save for a few important aspects. Two of the three standard ceretridon legs have elongated into wings that sit near the head of the critter, while the remaining leg

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has grown very large, lengthening its three fingers to support another (two-part) broad wing, one that is larger than the other two lifting members. The middle "finger" stretches through the fluke of this large hind wing and becomes a tail. The tail effectively pulls the beast's center of mass rearward, putting it at the center of lift located in the region of the massive rear wing. A triangular sonar "ear" sits ahead of the eyes on top of the "cranium." Sonar is the avian's primary sense, though their eyesight is good. Eyes in avians are often located on the side of the head, giving the creature a 360 degree field of view. Usually the other pair of optical sensors are highly atrophied.

Propulsion is achieved through flapping the two forewings, and lift is generated by the broad hind fluke. This is an effective combination, capable of carrying the animal forward at speeds similar to light aircraft.

Many avians have assumed the role of predator, pouncing upon ceretridons and snatching each other from the sky. There are large predators called the dracowolf, with wingspans over ten meters, that hunt solely by sonar, having atrophied eyesight. Such predators tend to feed on mid-sized avians, as well as many of the ceretridontids—avians have developed organs that the ceretridons don't have, and can tolerate a broader range of toxins than their terrestrial brethren. Other predators are small, like sparrows, and flock, attacking prey *en masse* like Earth's piranha. Pagodivorous avians abound, lying flat on tasty umbrella leaves with their wings outstretched, and camouflaged in detail to hide from sight predators.

The Uther

One lineage of avians has produced Epona's sophont, the uther. Singularly the most fascinating physiological trait of the species in the uther line is the interdependence of the parent and neonate. Uther young are born extremely undeveloped, being mainly a football-sized head and body with vestigial wings hanging from one end. The neonate's nervous system is also relatively undeveloped, save for eyesight, which is nearly as capable as any adult's. Being placed on the parent's back in a depression between the two forewings, where a single nipple is located, the neonate drinks a milklike substance for nourishment. Two vestigial fingers, one from each forewing, hold the young securely in place (unfortunately not shown in the illustration). Even with their sideways facing eyes, adult uthers are not able to see backwards very well, and, in this piggyback position, the neonate becomes a rear guard for the adult. A simple reflex response, the neonate will clamp down hard on the teat if a nonuther avian is detected, giving the parent warning of an attack. This symbiosis lasts for about five years, ending when the neonate is able to fly on its own. Having a neonate is of paramount importance to an adult uther, and rarely is an adult seen without one. There are potentially many cultural ramifications of this physiology, though, as with many things involving the uther, the social effects haven't

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been explored in great depth at this time.

Utheran cultural evolution is known in general. Early uthers were originally scavengers, flying in widely separated groups to aid each other in finding the rare corpse on the ground. There are a number of predatory species of avian that feed on the uther, and the groups served a dual purpose as some members watched for predators. Such organizing behavior resulted in a complex communicative ability which eventually evolved into language.

Due to the limited nature of the pentapod respiratory system, uther speech is somewhat restricted in scope. Uthers do not have any type of vocal cords, like humans, so are unable to make a similar range of sounds. Instead, uthers sing, or chirp, their words using a simple system of rising and falling high-frequency pitches. Sentences end with a simple marker note of a specific frequency, so that the uther "singing" is interrupted periodically with this somewhat random "beat." Uther writing looks like stock-market graphs, with the lines showing the rising and falling of various note arrangements for each word.

Having the typical weak chitinous teeth of pentapods, the scavenging and speaking uthers were not well suited for the task of eating raw meat. With their strong need, uthers eventually created cutting tools in order to process food easily. Sharp tools led to hunting, and a new lifestyle. One ramification of predatory uthers was direct competition with a number of large aerial carnivores, and many megaavian species slowly disappeared as the uther improved on its weapons technology. Indeed, avian species that fed primarily on the uther were the first to be eliminated from Epona.

Created by a need for watching their prey herds very closely, uthers learned animal husbandry. Maintaining the nomadic lifestyle of their scavenger ancestors, uthers initially followed ceretridon herds around guarding them from carnivores, both terrestrial and aerial. As uther populations grew, violent encounters with other bands increased, and a need for territory arose. Uthers created permanent settlements, at first in pagoda trees, to maintain control over specific lands. Under this close protection the herds grew, and quickly denuded the lands. As agricultural methods were developed to feed the voracious herd animals, full-fledged civilization resulted, with an accelerating technological growth.

IN CONCLUSION

The paragraphs above summarize only a few aspects of Epona, a tiny glimpse at a world that is very complex and detailed. Fortunately, for those who are interested in seeing more of Epona, there's an effort to depict the planet in its own publication(s). Epona is no longer restricted to *Contact*; in 1995, the participants of Epona's creation have established a partnership called WorldBuilders that continues the development of Epona, and is pursuing many paths to give the world a visible spot in the science fiction genre. ■

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THE ALCUBIERRE WARP DRIVE

The theoretical physicist Miguel Alcubierre was born in Mexico City. He lived there until 1990 when he moved to Cardiff in the UK to enter graduate school at the University of Wales. He received his Ph.D. from that university in 1993 for research in numerical general relativity, which is the art of solving Einstein's gravitational equations with a fast computer. He continues to work in this field and lately has been devising numerical techniques for describing the physics of orbiting black holes that spin down to collision. His Web page can be found at *http://www.astro.cf.ac.uk/pub/Miguel.Alcubierre/index.html*.

Two years ago Alcubierre published a remarkable paper that grew from his work in general relativity, originally formulated by Albert Einstein and still the "standard model" for space-time and gravitation. Alcubierre's paper describes a very unusual solution to Einstein's equations, described in the paper's title as a "warp drive" and in the abstract as "a modification of space time in a way that allows a space ship to travel at an arbitrarily large speed." In this Alternate View column, I want to explore Alcubierre's work and its implications for science fiction.

Let's start by considering the well-known velocity-of-light speed limit from the viewpoints of both special and general relativity. In the context of special relativity, the speed of light is the absolute speed limit of the Universe for any object having a real mass (i.e., anything but the semi-mythical tachyon), for two reasons. First, giving a fast object additional kinetic energy has the main effect of causing an increase in mass-energy rather than speed, with mass-energy going infinite as speed snuggles up to the velocity of light. By this mechanism, relativistic mass increase limits massive objects to sub-light velocities.

There is also a second faster-than-light (FTL) prohibition supplied by special relativity. Suppose a device like the "ansible" of Le Guin and Card were discovered that permitted faster-than-light or instantaneous communication. Special relativity is based in the treatment of all inertial reference frames (i.e., coordinate systems moving with a constant velocity) with perfect even-handedness and democracy. Therefore, FTL communication is im-

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plicitly ruled out by special relativity because it could be used to perform "simultaneity tests" of the readings of separated clocks which would reveal the preferred or "true" inertial reference frame of the Universe. The existence of such a preferred frame is in conflict with special relativity.

General relativity treats special relativity as a restricted sub-theory that applies locally to any region of space sufficiently small that its curvature can be neglected. General relativity does not forbid faster-than-light travel or communication, but it does require that the local restrictions of special relativity must apply. In other words, light speed is the local speed limit, but the broader considerations of general relativity may provide an end-run way of circumventing this local statute. One example of this is a wormhole (see my AV columns, *Analog* 6/89 and 5/90) connecting two widely separated locations in space, say five light-years apart. An object might take a few minutes to move at low speed through the neck of a wormhole, observing the local speed-limit laws all the way. However, by transiting the wormhole the object has traveled five light-years in a few minutes, producing an effective speed of a million times the velocity of light.

Another example of FTL in general relativity is the expansion of the Universe itself. As the Universe expands, new space is being created between any two separated objects. The objects may be at rest with respect to their local environment and with respect to the cosmic microwave background, but the distance between them may grow at a rate greater than the velocity of light. According to the standard model of cosmology, parts of the Universe are receding from us at FTL speeds, and therefore are completely isolated from us. As the rate of expansion of the Universe diminishes due to the pull of gravity, remote parts of the Universe that have been out of light-speed contact with us since the Big Bang are coming over the light-speed horizon and becoming newly visible to our region of the Universe.

Alcubierre has proposed a way of beating the FTL speed limit that is somewhat like the expansion of the Universe, but on a more local scale. He has developed a "metric" for general relativity, a mathematical representation of the curvature of space, that describes a region of flat space surrounded by a "warp" that propels it forward at any arbitrary velocity, including FTL speeds. Alcubierre's warp is constructed of hyperbolic tangent functions which create a very peculiar distortion of space at the edges of the flat-space volume. In effect, new space is rapidly being created (like an expanding Universe) at the back side of the moving volume, and existing space is being annihilated (like a universe collapsing to a Big Crunch) at the front side of the moving volume. Thus, a space ship within the volume of the Alcubierre warp (and the volume itself) would be pushed forward by the expansion of space at its rear and the contraction of space in front.

For those familiar with usual rules of special relativity, with its Lorenz

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contraction, mass increase, and time dilation, there the Alcubierre warp metric has some rather peculiar aspects. Since a ship at the center of the moving volume of the metric is at rest with respect to locally flat space, there are *no* relativistic mass increase or time dilation effects. The on-board spaceship clock runs at the same speed as the clock of an external observer, and that observer will detect no increase in the mass of the moving ship, even when it travels at FTL speeds. Moreover, Alcubierre has shown that even when the ship is accelerating, it travels on a free-fall geodesic. In other words, a ship using the warp to accelerate is always in free fall, and the crew would experience no accelerational *g*-forces. Enormous tidal forces would be present near the edges of the flat-space volume because of the large space curvature there, but by suitable specification of the metric, these would be made very small within the volume occupied by the ship.

All of this, for those of us who would like to go to the stars without the annoying limitations imposed by special relativity, appears to be too good to be true. "What's the catch?" we ask. As it turns out, there are two "catches" in the Alcubierre warp drive scheme. The first is that, while his warp metric is a valid solution of Einstein's equations of general relativity, we have no idea how to produce such a distortion of space-time. Its implementation would require the imposition of radical curvature on extended regions of space. Within our present state of knowledge, the only way of producing curved space is by using mass, and the masses we have available for works of engineering lead to negligible space curvature. Moreover, even if we could do engineering with mini black holes (which have lots of curved space near their surfaces) it is not clear how an Alcubierre warp could be produced.

Alcubierre has also pointed out a more fundamental problem with his warp drive. General relativity provides a procedure for determining how much energy density (energy per unit volume) is implicit in a given metric (or curvature of space-time). He shows that the energy density is *negative,* rather large, and proportional to the square of the velocity with which the warp moves forward. This means that the weak, strong, and dominant energy conditions of general relativity are violated, which can be taken as arguments against the possibility of creating a working Alcubierre drive. Alcubierre, following the lead of wormhole theorists, argues that quantum field theory permits the existence of regions of negative energy density under special circumstances, and cites the Casimir effect as an example. Thus, the situation for the Alcubierre drive is similar to that of stable wormholes: they are solutions to the equations of general relativity, but one would need "exotic matter" with negative mass-energy to actually produce them, and we have none at the moment.

The possibilities for FTL travel or communication implicit in the Alcubierre drive raise the possibility of

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causality violations and "timelike loops," i.e., back-in-time communication and time travel. Alcubierre points out that his metric contains no such closed causal loops, and so is free of their paradoxes. However, he speculates that it would probably be possible to construct a metric similar to the one he presented which would contain such loops.

A scheme for converting FTL signaling to back-in-time signaling requires some gymnastics with moving reference frames to invert the time sequence of the "send" event and the "receive" event in a signal transmission. I described such a scheme in a recent column on quantum tunneling and FTL signaling (*Analog*, 12/95). In the case of the Alcubierre drive, this would probably require either externally moving the warp generating mechanism at near light-speed velocities or embedding one warp within the flat-space region of another.

The implications of the Alcubierre warp drive for science fiction are fairly clear. If the serious theoretical and engineering problems outlined above could be overcome, we would have FTL travel, fully consistent with general relativity, that is reminiscent of the warp drives of the good old-time space operas. Remember, however, that using such a drive would undoubtedly require the manipulation of planet-scale quantities of energy (positive or negative). The user would also have to be very careful to avoid the tidal forces of the distorted-space region at the edges of the flat-space region containing the ship.

And there is also the question of writing the environmental impact statement. What would happen to external objects (space dust, rocks, other ships, asteroids, planets, . . .) that happened to lie in the path of an Alcubierre ship and entered the region of distorted space-time at the leading edge of the warp, where space is rapidly being collapsed? The nuclei of any matter transiting that region would first experience enormous compressional forces, probably form a quark-gluon plasma reminiscent of the first microsecond of the Big Bang, and then explode in a flood of pi mesons and other elementary particles when the compression forces were released, stealing energy from the warp field in the process.

A ship traveling in an Alcubierre space warp should be equipped with plenty of radiation shielding. Perhaps that is not a problem, since the equations for the metric and the energy density of the warp do not depend on how much mass is placed in the flat-space region that is given an FTL velocity. ■

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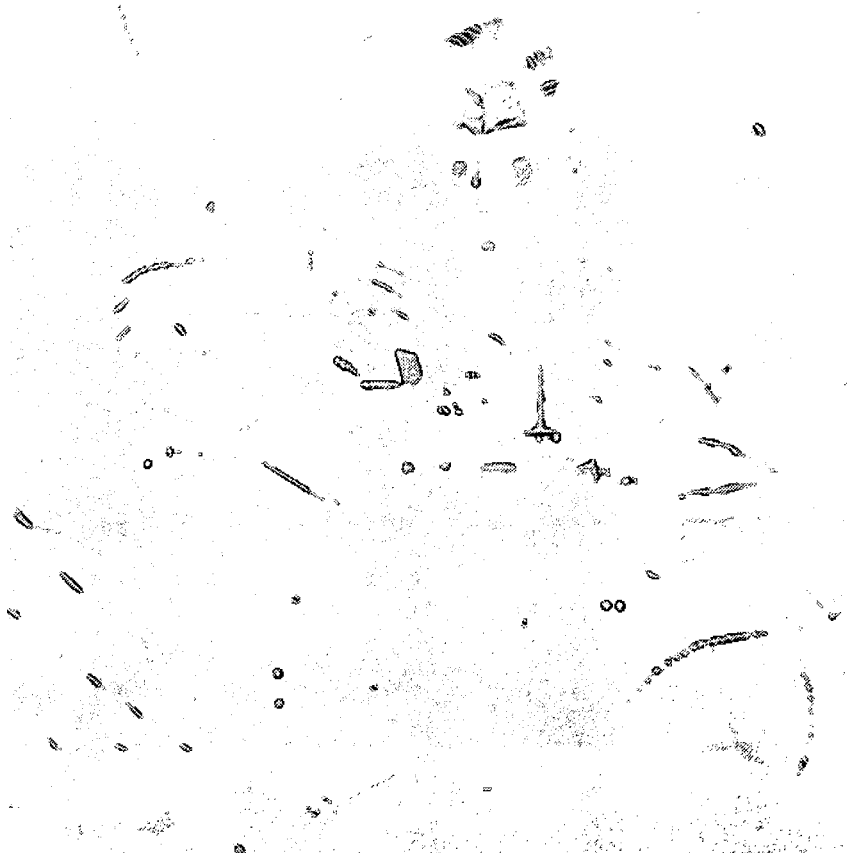
Jerry Oltion

THE SPECTRAL STARDRIVE

Just because a phenomenon looks "supernatural" doesn't mean you can't learn to use it—and maybe, eventually, even to understand it!

Illustration by Alan M. Clark



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Tilbey was the first guy I ever knew who could stare a firing rocket engine in the nozzle and survive to tell the tale. Of course he was dead at the time, so I don't know if that counts, but it sure impressed me.

Not that he was such a macho guy or anything. Alive or otherwise, he was mostly just a klutz. That's how he wound up dead in the first place. He'd been working on the main engine's ignition system, but he hadn't shut down the fuel feed first so he'd gone up in a puff of smoke the moment he switched on the injectors. There wasn't a thing we could do for him after that, so the rest of the crew—Peter, Gwen, Captain Hoxworth, and myself—all mourned his loss and headed on to Mars without him.

That's what we thought, anyway. But a few days later, his ghost came back to haunt us. Turned out he had a good reason: he'd forgotten to close the access hatch in the engine compartment, and the sensors that normally would have told us so had been damaged in the blast that killed him. If he hadn't warned us about it we'd all have gone up in an even bigger puff of smoke when we lit the engine for our deceleration burn into orbit.

Of course the ignitor had been damaged as well, which meant he'd had to light the engine, too. By hand.

So in the end he'd saved our lives, and we'd all assumed he had gone on to klutzy engineer heaven while we landed on Mars; but in the days afterward I began to wonder if that was really the case. See, he'd still left one thing unfinished: the blinking, buzzing, and totally incomprehensible *project* that took up a third of his quarters.

He hadn't been back, but that didn't mean anything. After all, ghosts slip through walls. That means they can't hang on under thrust. Tilbey had had a hell of a time just maneuvering around the ship when it was in free fall; he had to pull himself along like a swimmer through water, only in air and with him mostly insubstantial it was much less efficient. And when the ship was under thrust he'd dropped through the floor like it wasn't even there.

What kept bugging me was this: if he didn't pass on to his just reward after saving our lives, then when we decelerated to land on Mars he must have kept moving in a more or less straight line toward the asteroid belt. I didn't know him that well, since I was a new hire on the ship when he died, and I wasn't sure I quite believed all that had happened in the last few days anyway, but even so the idea made me shiver. To be adrift in space like that, without even the comfort of death to end your loneliness. . . .

It would be hell. And little as I knew him, I did know that Tilbey didn't deserve eternal damnation.

So on the day we were supposed to leave for Earth again, I found myself in the control cabin, explaining to Captain Hoxworth why we should take the long way home.

"It'll only add a week to the trip," I pointed out to him as I outlined the course and the fuel requirements on the navigation computer.

He floated just overhead so he

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could see my figures. "And it'll shoot our profit for the entire trip," he said. "Profit that already went into repairs on the main engine, which means we'd be dipping into the emergency funds."

"Isn't rescuing a crewmember an emergency?" I asked. He ran a hand through his silvery hair, leaving it no worse off than before. He always looked like he'd just taken off his pressure suit. "Tilbey's already dead," he said, but he said it without conviction. He'd seen the apparition, too.

Gwen had been logging in our cargo manifest; she looked up from the comp and said, "Danny's right. We owe it to him to go look."

"Look where?" the captain asked. "We don't have any idea how strongly he interacts with matter, or if gravity will affect his trajectory. He's had nearly a week to drift. He could be anywhere in a volume of space a billion kilometers on a side."

I had already thought of that. "On the other hand," I said, "he already caught up with us once. We know he has some control over his position in space. I figure if we just get close, he'll be able to do the rest."

"If he even knows we're there," grumbled the captain. "And what do we do if we catch him? We can't take him anywhere. The moment we fire the engine he'll fall right through the deck again."

He had a good point, and I hadn't figured out an answer to it, but I figured maybe Tilbey would have some ideas. He was the engineering genius, after all, and he'd had plenty of time to think it over.

Hoxworth took his time as well, trying to find a way to weasel out of the obligation without giving himself a guilty conscience, but in the end he couldn't do it. He sighed heavily and said, "You win, Mr. Danbury. But if we go broke paying for this little junket, it's coming out of your paycheck first."

I laughed nervously, not knowing whether or not he really meant it. And by the time I realized he was serious, it didn't matter, because I was dead, too.

It was a stupid accident. I was in Tilbey's quarters, looking at his project for the fourth or fifth time since he'd died, wondering what it was and how I could safely shut it off. I'd found no obvious on/off switch, only a few unlabeled knobs, some pilot lights, (three of which blinked irregularly), and dozens of wires leading from them to a cluster of gray metal boxes that presumably held the bulk of the electronics. Wide black tape held the whole works together and secured it to the work table, which was in turn festooned with tools and test equipment Velcroed to every surface.

The rest of Tilbey's quarters were no better; candy wrappers and empty drink bulbs nearly blocked the ventilator intake, and clothing had snagged against practically every projection. I was gingerly picking through it all, looking for clues, when I finally found a notepad under his bunk. I dusted off the screen and turned it on, and found it full of notes and equations describing "vector coupling constants," "massless driver persistence ratios," and similar terms. It took a few pages

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before I realized that Tilbey was describing some kind of interstellar spaceship drive. An engine that would somehow remove the mass from an object so it could be accelerated to the stars.

If that was what this blinking, humming monstrosity before me was, then we had more to think about than just a ghostly crewmember. I pushed myself up off the bunk, notepad in hand, planning to take it to Captain Hoxworth, when the navcom made a sudden course change, probably to avoid a piece of space junk, and I fell right into the project. I learned in a hurry that the bare wires along the top, at least, weren't safe to touch. It felt like they were carrying at least a thousand volts, for that brief moment when they felt like anything.

Fortunately it happened after we'd lifted off Mars and done our maneuvering into the volume of space I'd calculated Tilbey should be in, or I'd have been left behind. As it was I stayed with the ship, though I knew from Tilbey's experience how precarious that was.

Panic, I discovered, is mostly hormonal. As I looked at myself drifting there beside Tilbey's gadget, obviously dead, my hair still smoking from the current, my first thought was, "Oh, hell, not me too." Close afterward I thought, "Captain Hoxworth isn't going to like this."

I wondered if maybe I could undo it, slide back into my body and jumpstart my heart again, but when I reached out to touch myself my hand went right through. My new self was as insubstantial as fog, and about as well defined. I couldn't even tell if I was clothed. I was just a white, vaguely human-shaped patch of mist. If I extended a single finger, I could see it as a separate digit, but otherwise my hand looked like a blurry mitten.

Using my blurry appendages, I flapped and swam the way I'd seen Tilbey do and I eventually began to move toward my body. I contorted myself around so I was in roughly the same orientation, but it did no more good than simply touching had. I just passed through and out the other side, and came to rest halfway into the wall beyond. The lights flickered as I apparently shorted out the wiring inside the wall, but I shoved and flapped myself free before anything blew. In the process I discovered that the wall provided better traction than simple air did, but even so, pushing off from it worked nothing like it had before I'd become a ghost.

A ghost. There was no avoiding the truth. Nor could I ignore the obvious: both Tilbey and I had died suddenly on board the ship and come back to haunt it. Since I had heard of maybe a dozen ghosts in my whole life, and never seen any good evidence for any of them until Tilbey, it stood to reason that something on board this ship—almost certainly his project—was responsible. It might have been a prototype stardrive, but by the looks of things it made a pretty good ghost generator as well.

Like it or not, Captain Hoxworth needed to know about this. It took me twenty minutes of swimming to pull myself forward to the control room. Half that was spent getting up

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some speed, and the other half slowing down. I hung close to the walls for traction, but that had its dangers; I kept shorting out the wiring, and in one alarming moment I misjudged my direction and slipped right out through the hull. I felt genuine panic then, but after a few minutes of frantic flapping I learned that I could push against space almost as well as I could against air. Maybe it was magnetic fields I was reacting with, I didn't know, but whatever it was that provided me with traction I was glad to have it.

It was also encouraging on another front: It meant Tilbey probably wasn't as helpless out there as I'd feared. Then I did the math to figure out how much swimming it would take to change his velocity by even a thousand kilometers per hour—which is hardly anything to an interplanetary spaceship—and I nearly gave up. Because if I had miscalculated even a little bit on Tilbey's trajectory, then one of us had a lot of swimming to do to catch up with the other.

Captain Hoxworth wasn't in the control room when I finally drifted through the last bulkhead and frantically flapped my way to a halt. Peter was, but he was asleep. The book he'd been reading floated free, tumbling slowly end over end just a few inches from his nose, its backlit screen giving his skin an eerie blue tint. I resisted the urge to nudge it back toward him; I didn't want to ruin it. So instead, I just tapped him on the shoulder.

My hand went right through him, of course, with hardly any more resistance than you'd feel pushing through a spider web, but the effect was evidently more pronounced on his side. He shot up in his chair and would have pitched right on into the control console had his harness not stopped him. He looked right at me—right *through* me, I could tell by the way his eyes tracked—then he flinched again when he realized what the foggy patch in front of him was.

"Tilbey?" he asked. His voice sounded tinny and distant. Air didn't vibrate my eardrums any better than it pushed against my hands.

"No, it's me, Danbury," I said, though I knew it was pointless. Tilbey had tried to talk to us, too, and he hadn't been able to make enough sound to be heard. So I just shook my head and waved my arms back and forth and pointed downship toward Tilbey's quarters, where my body still lay beside his mystery machine. Then I flapped my way over to the datacomp and stuck my finger into the keyboard, trying to access the e-mail menu so I could type a message. One thing I could do was short things out, which meant I could use a keyboard if I was careful not to stick my finger through into the processor.

Peter saw what I was trying to do and brought up the mailer for me. When I got a clear screen, I one-finger typed as carefully as I could, *I'm Danbury. Elctrcutd in Tilbeys quartrs.*

"Ah, hell," said Peter.

Call captn, I typed, but he was already doing it. Hoxworth and Gwen showed up together.

Hoxworth took one look at me and at what I'd typed, then burst into a fit

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of cursing, which he ended with, "Gwen, kill the power to Tilbey's quarters. We should have done that days ago."

"No!" I shouted, but Gwen was already moving toward the environmental control panel. I waved my arms and tried to catch her, but it was no contest. She reached the panel, punched up the ship's power schematic, and killed the circuit before I could even begin to move.

"What's he so excited about?" Hoxworth asked, but if anybody answered him I never heard it, because just then the Universe went where candle flames go when you snuff them out.

I came back to consciousness an instant later. It must have been a bit longer for them, because Gwen and Hoxworth and Peter were all looking around the control room as if they were trying to locate a mosquito, and Hoxworth was saying, "Damn it, I said I was sorry. I had no idea it would do that."

"Well you've got to think of that sort of thing before you—" Peter said, but Gwen suddenly pointed toward me and said, "There he is!"

Hoxworth and Peter spun around, and Peter asked, "Are you all right?"

Gwen laughed. "Aside from being dead, of course." That seemed a bit tacky to mention just now, but I decided she was just trying to handle the idea that another of her crewmates was now a ghost.

"I'm fine," I told them, and I typed it into the comp for them to read.

Peter and Captain Hoxworth settled down a bit as well when they read my reassurance. After a moment, Hoxworth brightened a little and said, "Hmm, I wonder if Tilbey blinked out just then, too."

"Probably," Gwen said. "Are you thinking what I'm thinking?"

"What?"

"If we can make him blink on and off like a light, the wide-field debris scanner might pick him up. It mostly relies on radar echoes, but it does have optical sensors as well."

"Oh no you don't!" I shouted, typing furiously. My message looked like *ooohno yoou dont dontt do thatt!,* but they got the idea.

"Why, did it hurt?" Hoxworth asked.

No, I reluctantly, typed. *But—*

"But what? We'll blink you once more and scan for Tilbey at the same time. What's the big deal?"

Eternity, I typed. *Oblivion. The bigg sleep. I was* nowhere *when you did that.*

"But you came right back," Hoxworth argued.

You want to try itt? I typed. That slowed him down, but only for a second.

"Look, you were the one who wanted to find Tilbey," he said. "We're out here in the middle of nowhere because of you, and he hasn't showed up on his own, so it looks to me like we're going to have to track him down. If you've got a better idea, I'm open to suggestion."

I tried to think of something else we could do, but unfortunately Hoxworth was right. The wide-field optical cameras were perfect for finding faint, blinking objects. That's what they were designed for, after all; to

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spot tumbling space junk before it plowed into the ship at interplanetary speeds.

I did have one thought. Would Tilbey be as bright as me, out there in space? I could still see a fuzzy outline of my former arms and legs, and I remembered Tilbey glowing a soft white, about as bright as a single Christmas tree bulb, but we'd never checked to see if that was an intrinsic light or a reflection. I leaned over the keyboard and typed, *Do I glow under my own lightt?*

"That's easy enough to check," Gwen said, and she switched out the cabin lights.

I went out as well. For a moment I felt like a disembodied viewpoint adrift in space, and then I realized that was pretty close to what I actually was, but hard on the heels of that thought came the realization that I would have pretty much the same sensation if I were still alive, too. We were all in free fall in a dark room.

Gwen shined a flashlight around the cabin, and when the beam swept across me I lit up bright as day. "Great!" she said. "All we have to do is trigger the emergency beacon at the same moment we kill the power to Tilbey's gadget, and we've got us a ghost detector."

Her logic seemed a bit off to me, but it took me a moment to pin down why. I waited for her to turn on the lights again so I could see to type, then I wrote, *If you switch him off whenn you flash the lights, there won'tt be anything there to detecct. Just flash the liggts and leave us be.*

"Oh," she said. "Right. Sorry."

Sorry, I thought. We're talking oblivion here, and she says sorry. But I didn't type anything.

So Gwen switched on the beacon and let it blink for a few seconds. It's bright enough to call attention to itself over a million kilometers away; it didn't take long for the debris scanner to start finding reflections. Most of them were genuine space junk, all on widely different trajectories, but one reflection was moving along our own path just thirty thousand kilometers behind us and closing at a few hundred kilometers per hour. It would take days to catch up at that speed, but it was hard to believe that something could be following us by sheer coincidence.

Why don't you ggo see if it's him? I typed.

"What about you?" Hoxworth asked. "You'll fall out of the ship if we use the engine."

You can come back for me, cann't you? I typed. *In the meantime, I'll try to match Tikby's velocity.*

"How?" he asked, clearly skeptical.

Swim, I typed.

I pushed myself out of the ship first, so I wouldn't fall screaming through it when they lit the drive. I didn't like the idea of watching the decks rush toward me, nor did I want to short anything else out on the way through, and I didn't want the flame blasting through me as I fell out the bottom, either. Tilbey might have stared it down without fear, but I take a more cautious approach to things. I didn't know what was sustaining my consciousness beyond death, but I didn't want to test

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the limits of its endurance.

As I watched the ship dwindle in the distance, I started swimming the way we'd originally been headed. That was away from Tilbey, but it was the same direction he was moving and he was going faster than me, so that was the way I needed to go if I wanted to rendezvous with him. I tried to calculate my velocity change while I pushed myself along against the ether, or the magnetic fields of the Solar System, or whatever it was I was interacting with. At a ballpark estimate of a centimeter per second acceleration for every stroke, call it one stroke per second, that gave me a meter per second of velocity change every minute and a half. Some stardrive, I thought. What were we supposed to do, swim all the way to Alpha Centauri? Tilbey obviously needed to refine his invention a bit before he applied for a patent.

All the same, a centimeter per second squared does add up. If I could keep at it for just a couple of hours—and it seemed like I might be able to, since I didn't feel tired yet—I could match velocity with Tilbey. Of course I'd still be about twenty-five thousand kilometers ahead of him, so I decided maybe I should slack off a bit and watch the stars for a while, let him catch up, and then match velocities.

It was pleasant drifting there in deep space, free of all the aches and pains and hormonal baggage that comes with bodies. Some part of me knew that I should be terrified, that I should be struggling frantically to resuscitate my body and shoehorn my center of awareness back into it, but I just couldn't work up any urgency. Now that I'd survived it, death didn't hold near the terror it had before. At least not the kind of death I'd experienced. I'd had a bad moment when Gwen had shut down Tilbey's gadget and me with it, but apparently nonexistence was the big fear, not what form I existed in.

That led me to another comforting thought: for Tilby's machine to work, there had to be something for it to act upon. Some part of me had survived after death, some natural part that the machine had enhanced to create a ghost. And it had survived a momentary power outage as well. I wasn't religious, and my lack of any experience at all while in the unenhanced state made me disinclined to become religious now, but at the same time it was a comfort to know that some essential part of me persisted on its own.

The stars were bright hard points all around me. Without even a spacesuit visor between me and them, they felt almost close enough to touch. It came to me that Tilbey might not want to be rescued. This wasn't the hell I'd imagined it to be. In fact, it was pretty close to the peak experience for someone who had always wanted to spend the rest of his life in space, which had been my ambition since the moment I realized it was possible. I didn't know if Tilbey felt the same way as I did about it, but I wouldn't have been terribly upset if the ship didn't come back.

As long as they left the gadget running. And so long as they didn't take it out of range, however far that might be. After all, I had no assurance that

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whatever natural part of me the stardrive acted upon would last forever without its help.

Suddenly I started getting nervous. Maybe that wasn't Tilbey back there after all. Maybe he had faded out once and for all when we'd stopped on Mars and he'd looped on past at a couple thousand kilometers per hour. Maybe *I* was about to do the same.

I started flapping madly back the way I'd come. So of course I was doing a couple hundred klicks per hour *toward* the ship by the time they returned. They probably got some amusing pictures of me in the wide-field cameras when they fired the emergency strobes, pictures of me flailing madly at nothing at all, and for no reason. For of course the signal they'd gone to investigate had been Tilbey after all, and they'd come back to let me know they'd found him.

We had an amusing time matching velocities. Amusing to everybody but us, at least. Tilbey and I had to swim like crazy for hours before we came together, and even then we had a hell of a time with the final approach. Fortunately we didn't grow tired, but just when it looked like we might both make it inside the ship at once Tilbey accidentally swept his arm through one of the attitude jets, which promptly fired and sent the ship into a spiral, tossing us both free like water drops off a wet dog's back. When we tried it again he blew the main power grid to the starboard circuits, and we both blinked out for a moment until the breakers reset themselves. Whatever physical changes he had undergone, Tilbey hadn't lost his klutziness.

We finally convened in his quarters. It was a good thing we were in free fall; the gadget and my corpse took most of the floorspace. Gwen and Peter and Captain Hoxworth eyed both with equal discomfort, and Gwen apologized for not thinking to put the body in the freezer, but I told her not to feel bad. It was my body, and I hadn't thought of it either. We'd all been too busy to worry about that sort of thing. Now, however, it raised a good question for Tilbey.

So is there any way to put us back? I asked. We were using his notepad, whose holographic keypad responded better to our spectral touch. Maybe because it was no more substantial than we were.

I don't think so, Tilbey typed. *This wasn't supposed to happen in the first place. The stardrive was only supposed to stabilize an object's form independent of its mass, not separate us from our bodies. I don't think it would have latched onto us at all if I hadn't left it running with no target.*

"You mean this is all a *side-effect?*" asked Peter. Tilbey gave a ghostly shrug, then typed, *Well, yeah. It's still experimental, after all.* He cocked his head a moment, thinking, then typed, *Could someone adjust the coupling constant a bit higher? That might help us interface better.*

Captain Hoxworth looked at the rat's nest of wires and lights. "Coupling constant?" he asked.

Tilbey pointed at an unlabeled knob and pantomimed twisting it clockwise. Hoxworth gingerly gave it an eighth turn or so, and I immediately noticed a difference. The sound lev-

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el grew louder, for one. I reached out to the wall and gave it a soft push, and though my hand still went through it, I felt a lot more resistance than before. I floated across the room toward the other wall, and actually stopped when my feet reached it.

"Yeah, that works," I said. "Crank it up some more." Captain Hoxworth obligingly turned up the constant another eighth-turn, and I realized that he'd heard me speak.

I noticed Gwen blushing, and I realized that Tilbey and I had taken on much more well-defined form now, too. And no, clothing apparently didn't persist after death.

But Tilbey took my mind off modesty when he said, "Be careful. It takes a lot more power the higher you go."

"Wonderful," Hoxworth said. "We're already over budget." I shivered at the thought that economic considerations might force him to turn me down again. Or that a circuit failure might wipe me out completely. "We can't go on like this indefinitely," I said. "There's got to be a way to give us some kind of permanent form."

Tilbey shrugged. "Permanent is no problem. We're essentially a set of standing waves. Very stable as long as the power holds out. I designed all this for an interstellar voyage, after all."

Peter snorted. "On what ship? Nobody's built anything that'll cross interstellar space in less than a century. Even the one-way probes take forever."

Tilbey shook his snowy white head. "No, no, that's what this is supposed to *replace*. The only actual mass we need to send is the generator, and once we miniaturize the electronics we can probably get it down to less than a kilogram. *That* much we can boost up close to light-speed, so it would only take a few years for the trip. Less, subjectively, since we'd have relativity working for us. And once we get where we're going we can zoom around all through the planetary system without using any reaction mass at all."

I remembered how I'd enjoyed drifting in space, the stars hard points of light all around me. Once we adjusted our interface so we could get around a little easier, we probably could swim from planet to planet, and move around on the surface with relative ease as well, exploring every nook and cranny without fear of danger. There wouldn't be much that could hurt us, because we would already be dead.

I don't think I'd have gone for it if fate hadn't already forced my hand, but considering my alternatives, it actually sounded pretty good.

"So let's get busy and do it," I said. "Where do we start?"

Tilbey leaned over the device. "Well, I guess we need to calibrate the intensity settings, and find out what our distance limits are, and—yow!" He had reached in to adjust another knob, but of course he'd shorted it out instead. Sparks flew, and I felt myself grow massive as an asteroid for just a second before Tilbey jerked free and things settled down again. Some of the debris in the room had begun to drift toward us, but the effect was

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too short-lived for any of it to pick up any real speed. So I plucked an empty coffee bulb out of the air and helped it along toward Tilbey's head.

"Hey," he said, batting it aside. "You don't have to get mad. It was an accident."

Yeah, right. A Tilbey accident. The thought of working with him for months to come, and exploring with him for years afterward, momentarily made me shudder. But I forced myself to be calm, and even managed a reasonably sincere laugh. It was either that or murder him on the spot, but considering what had happened the last time he had died, I figured I had best leave well enough alone. ■

Editor's Note: this story is a sequel to "Unfinished Business," in our October 1996 issue.

IN TIMES TO COME

Our December cover story has nothing to do with Christmas or Hanukkah, but it is very much a holiday story—in a much more fundamental sense. Most humans tend to think of their most significant holidays as marking something particularly significant about their own religion or ethnic group, but the very concept of "holiday" is at heart a social invention whose purpose transcends any such boundaries. The exact nature of a holiday, though, depends on the circumstances under which its creators live; to serve its anthropological purpose well, it must be tailored to their needs. So when humanity travels to the stars, they may have to leave their old holidays behind and create new ones. I doubt that any of our readers have celebrated the one in John Vester's "A Replant Day Carol," but I think most of you will find resonances, and quite a bit to think about, in it.

We'll also have a new novelette by A. J. Austin and Daniel Hatch, plus stories by Jayge Carr, Rick Shelley, H. G. Stratmann, and Joseph H. Delaney. And in our fact article, James Benford takes a close and occasionally surprising look at one of the tools we might use to *get* to the stars: "The Power Beaming Route to Space."

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Mark Rich

FOGGERY

We all know how certain tabloids picture first contact. But if it fell into the lap of a slightly different kind of reporter. . . .

Illustration by Dell Harris

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"Take me to your leader," said the voice above me.

"Huh?"

I looked up.

"Oh, Mr. Fogg?" said Adelaide Jones from the third desk in the news room.

"Mr. Fogg!" said the man at my desk.

Observe that word: *Man*. I have no intention to be sexist. But, damn it all, if I called the thing standing at my desk, as green as a celery stalk (and looking about as stringy, may I add)—anyway, as I say, if I called that thing *Woman*, I would be up on charges of degenerate sexism, which is hardly my intention. Please: let me call him a man. He was anything but. *But* I would rather not call *it* a *her*. I did have the evidence before me, moreover, of his wearing clothing stereotypically male, at least in our society: blue overalls, blue work-shirt, and a straw hat, out from which his antennae poked. The clothes looked good, if a bit baggy on this particular vegetable.

"Mr. Fogg!" he said, having learned my name from Ms. Jones. "Take me to your leader!"

"I'm afraid this company bought out the *Telegraph Leader* a couple years back," I said. "The *Daily Hologaph*'s the only game in town, now."

"No, no!" the Celery Stalk said. "Your *leader!*"

I sighed. "I was afraid you said what you seemed to be saying. Let me tell you." I lowered my voice so Adelaide could feign not overhearing. "We don't brazenly say 'leader' around here, because it's offensive to the unempowered and to all people on lower rungs of business or social hierarchies."

He looked puzzled, insofar as a vegetable can look anything.

"Mr. Fogg?" Adelaide said. "If you don't mind me interrupting. I was just wondering if you had mustard."

"Actually, I do have mustard," I said, pleased to have been asked.

"Because I brought a folio, and it's pretty dry," she said.

"Sandwich" has fallen out of the vocabulary, out of deference to the Islanders.

I looked at the celery at my desk.

"Mr.—?"

"Extwizl," he said.

I think he said "Extwizl." It may have been Xtwzl, for all I know. I wish I did. Getting native spellings correct is so *aujourd'hui*.

"Well, Mr. Extwizl? Would you be so good as to take this jar to Ms. Jones?"

I was glad this folio business came up. I had noticed Adelaide the other day in the way a young male reporter will notice a new, young, female reporter—that is, in a non-reportorial way.

Mr. Extwizl moved with a complex up-jiggle, down-jiggle, swish-over, down-swoop, and up-jiggle again, accompanied by numerous micro-swivels. All this movement caused the orchestral batons that protruded from his occiputs to bounce up and down.

"Hey, thanks," Adelaide said to the differently complexioned man, who handed her the mustard. "Say, that's a nice departicularizer you have there."

In the days before they realized how scientifically demeaning it was, people would have called it a "ray-gun."

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"Take me to your leader," he said to her.

"On lunch hour?" she said. She shrugged, an uncommonly common expression of responsibility here at the *Daily Holograph*. "That would be Mr. Fogg." She pointed to me.

He returned to my desk, turning colors as he advanced. He shaded down to such a dark green that he would have been invisible in a fern bar.

"Take me to your leader!" he said.

"You're still asking that, are you?" I said. "What you have to learn, Mr. Extwizl, is that we ignore people who use that word. You imply that the rest of us are followers! And this is a democracy, buster!"

"Very well!" said Extwizl. "You deny me!" He pointed his departicularizer at Addy. "If you don't take me to your leader immediately, I will zot your co-worker's ventral conic protuberances, beneath which I believe that vital organ, the beater, must lie!"

I put hands over eyes and elbows on desk. This walking vegetable was all suction cups.

"Mr. Extwizl," I said. "Please. Around a lady!"

"A lady?" he said.

"A woman."

"And what do you mean by that?"

"I mean she is a woman in just the sort of way I am a man. In the opposite way, that is. Get with it, my man."

"I am *not* a man. *You* are of two sexes?"

"Only one, myself."

"You don't have one *leader?*" said Extwizl.

"I'm about all there is, during lunch hour."

"But this one you call Ms. Jones is not your same sex?"

"Of course not. But I don't know what that has to do with anything." I said this even while glancing at her and realizing that, yes, indeed, it had a great deal to do with something. Maybe time had come to do something about that something.

When I looked back at our visitor I noticed his antennae had lost their quivering pertness. He reminded me of my philodendron at home. He could use a good watering.

"Mr. Fogg?" he said.

"Yes."

"Could you point me to your—facilities?"

"Certainly. Right over there."

Once he was out of sight I felt elated and calm, having decided on a course of action.

"So," I said to Addy, "I've been meaning to ask. How about supper tonight?"

"Hi, guys!" said Jodi Simmons, returning to her post at the news desk. Hardly a day passed but she cut short lunch to get back to work. A workaholic, we called her once, before people started wondering what workahol was and where they could get some.

She rubbed her buzz-cut head while looking over Addy's shoulder. "Any more news on those frigging meteors?"

"Meteorites, not meteors," I said. "Once they hit Earth, they're called—"

"Weird, isn't it," said Addy, reaching for the ringing phone. "They made such a big show coming down, then hardly a sound when they hit.

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You'd have expected the earth to shake or something."

"Lots of guys that way," Jodi said. "Hi, Ed."

The janitor had just appeared at my desk.

"You look a little green, Ed," I said.

Addy put her hand over the receiver. "Guy here claims things landed on his farm. Went to look, and someone gassed him. Stole his clothes."

"I was wondering about the mess in the bathroom, Mr. Fogg," said Ed, wiping his forehead with a hankie. "Want me to clean it up, or you folks want to snap pictures first?"

Ed, a big, solid, dependable mass of a man, sat squarely on the end of the human spectrum away from those who succumb to the sweats. Yet here he stood, mopping brow.

"What mess?"

"In the bathroom. Dead alien, looks like to me. Shot himself in the chest. Burnt a hole clear through."

"Poor guy. But you know, Ed, you should watch your language. Take that word 'alien.' It's got a pejorative ring. Why not just say, 'a person of foreign birth,' or call him by his country of origin? You could say Mexican, or Canadian, or Los Angelino. What was he?"

"Martian, is my guess."

"Oh, that person of color," said Adelaide.

"Must have had lunch at the Chinese Lantern," I said. "MSG turns me green, too."

"Then let's not go there," Addy said.

"A Martian cooked itself in the squatter?" whooped Jodi.

"You mean we have a date?" I said to Addy.

"Where's that Wippett Snolligan?" Jodi banged her desk. "Let's get holos of that baby! An alien, really, Ed?"

"Must have been that Extwizl," I said. "Very troubled man. He thought this was a fishing supply store and kept asking for leader."

Jodi hammered her desk again. "Get this on front screen! Get this out on the net!"

"Sorry," I said. "We put Screen One to bed. We held it up long enough as it is, waiting for more meteorite stuff. Put it in tomorrow's edition. Addy? Do we really have a date?"

"Only because you always look so spiffy. I mean, you know, the last guy who asked me out dressed in *women's* clothes, if you can believe that."

"Tomorrow!" Jodi rolled her eyes. "Holy Jesus on a hot plate, Fogg! Our very own walking meteor hops in the head and commits hari-kari and you don't want to stop the presses?"

"So should I leave the mess for now?" said Ed.

"Oh, and this Mr. Hock on the phone," said Addy. "He wants his clothes back."

"Kind of a mess now," said Ed.

"You know, Jodi," I said, "it's pronounced *hara-kiri*. Or better yet, you should say *seppuku*, if you want the right word."

"Wippett!" cried Jodi. "Get in here lickety-split! Here's my headline, Fogg. ALIEN EXTWIZL SELF-SIZZLES! How's that?"

"I'd be glad to clean it up for you folks," said Ed, "if you just give the word."

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"There's a word for that kind of headline," I said to Jodi. "And you think it's good enough leader to stop the presses?"

"Benny Fogg!"

The thickest newsroom babble could not block the stentorian voice of Jerome H. Wire, editor-in-chief of the *Worcester County Daily Holograph*.

He stalked to my desk preceded by the aromatic harbinger of martini, and led by the predatory beak of his hawk-like visage.

He held the copy Addy and Jodi had prepared, shaking it as a dog shakes a sock.

"Am I to understand," he said, "these events happened on your watch?"

"Yes," I said, pleased at the recognition.

"Am I further to understand you planned to run nothing today? Nothing at all?"

I registered that Mr. Wire tempered his usual tenor of approval. In fact, I detected a baritone of opprobrium.

"Yes, sir," I said, nearly audibly.

"*And* am I to understand that you, Fogg, have gone clear out of your mind? Fogg, I cannot understand how you can be so unaware of your own stupidity when you make it so perfectly clear to everyone else!"

I never saw a kettle go to it so quickly. One moment, calm, balmy Mr. Wire, gaily shaking our copy. The next moment, tea-time.

Indeed, substance overflowed from Mr. Wire's censorious spigot worthy of steeping the most stubborn tea bag.

About Benny Fogg, now. I must note that when placed in piquantly hot water, hot enough that I notice its advanced degree, in other words when it becomes very nearly post-graduate, then I come to. I wake up, so to speak. I find blood in my brain. A few thoughts on this and that zip through the noggin, usually on their way somewhere else. Occasionally one stops. As now.

"But Mr. Wire," I said in my calmest voice, "of course we wanted nothing in today's edition—because this was so *big* a story it needed a Special Edition!"

"Special Edition?"

"Special Ed! Set it up in the Net! Sure cure for mid-summer, low-readership doldrums. Subscribers see hot headline, and pay an extra two bits to access. Invasion by alien vegetables, boss!"

Wire looked skeptical. "Then why didn't you interview this thing?"

"It was carrying a weapon. Besides, there must be more of those guys. I mean, an interview's a cinch."

Wire's look of doubt wavered—sure sign of trouble. Then his smile broke like a sunrise.

"Excellent, Fogg," he said. "So get going! Wipp! Go along! Send chunks of copy on the way there!" He twisted his hands behind his back and stalked a circle. "We'll patch it together, put in as many sidebars as we need to fill it, and we'll be in business. Grand, Fogg. I'll get the ad people going pronto. Brilliant!"

"But Mr. Wire?"

"Go to it!"

"Guns. They have—"

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"You faced one down before! Go, Fogg!"

"But maybe if I had backup, maybe the County Regiment or the Kid-scouts, or—"

"And have word get out? And have our story scooped?"

"But Mr. Wire—"

"Fogg! Are you this moment not out the door and gone? Fogg? Fogg! I ask you!" He cried this out using full *diapason* and *swell* of his majestic pipe organ, reminding me of the fact—excuse the sidebar—that the Vikings used the rune for "Os" to describe the wisdom of their headsman. In reality, "Os" simply meant he was some loud-mouthed old bastard. A good leader needed to be heard, especially when a fierce, salt-encrusting gale swept the boards and tattered the sails. He needed to shoot the breeze, so to speak. Or raise a storm himself. Just so in the modern newsroom.

Thusly reminded of Wire's qualifications, I answered his question with action rather than words, showing Wire and the newsroom my most sterling, not to speak of my back, side.

"Wipp, I am in the deep poop," I said to the man once we found ourselves safely in the van. I wiped the sweat from my brow and waited for the air-conditioning to kick in. "Hot Days for Mid-July" had been one of our inspired headlines for today's edition. "I believe I have never been deeper into the poop than I am right now."

He nodded judiciously. "Yes," he said in that relaxed way of his.

"I mean, will we come out alive? Who knows? These are beings from outer space, Wipp. Aliens. Extra read-all-about-it terrestrials, Wipp!"

"Ah. Yes," he said, with feeling.

We spun out of the lot, with Wipp at the wheel and me at command-and-control. A map appeared on my fore-screen: the way to Hock Hoggery, at the edge of W. County, sent by A. Jones.

"And now look at this. Here at the bottom," I said.

"Can't. Driving."

"She says, 'Hold on dinner plans till you make good with Wire.' From Addy Jones. A cancellation of my date, Wipp!"

"You have a date?"

"It took all lunch hour finagling that."

"Weren't you dealing with an alien?"

"Well, yes, that, too."

"You outdid yourself, Fogg."

"I suppose I did," I said, feeling better.

"And landed yourself in—"

"Don't say it!"

If I have postponed describing Wippett Snolligan, I have done so out of a sense of inadequacy. I am in awe of the man, his mind, and his abilities. His life spans larger than the page.

Turning a cold gaze upon him, however, reveals the salient facts, viz., that he is no taller than me, and I stand no taller than Addy, who I guess to be five-eight; of ruddy complexion, as though he loved a good, sleety wind rather than a shower in the morning; and of stouter build than mine, with more lumpishness about the arm from toting apparatus. A

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sound man all around.

"Wipp," I said, "I need your brains. How do I get an interview out of these aliens? As soon as they discover I'm responsible for the death of their front scout, they'll be tough subjects."

"But the alien did himself in, I thought."

"Yes, but I pushed the poor turnip into it, Wipp. I must have. I see that now. I had a little conversation with him. I must have been a bit strong. Manly words, you know, the way you might talk to a bowl of lettuce to crisp it up."

"Then they must not have much spine for abuse."

"If they're vegetables they *have* no spine."

"Why don't you tell me what happened exactly, Fogg?"

I filled him in on the precise details of the noon-hour, fudging only in toning down my obvious heroism and nobility of carriage during the affair. Modesty pays, I have learned; and one might as well be paid, since sometimes one is paid immodestly.

"All that," he said when I finished, "suggests easy success in the field."

"Except for this," I said, pointing to my screen. "Sometimes I regret the invention of electronic communication."

He regarded me questioningly.

"Look at my situation," I said. "I'm headed into vast danger. Now shouldn't I set out with the knowledge I can return to outstretched arms—or at least favoring glances—or, failing that, at least a *date* with an esteemed member of the sex opposite?

"But no. Here I set out, with this devious arrow through the heart."

"It's tough," he said.

"Think what it would have done to modern literature," I said, "if they'd had this stuff back in the first war. Imagine Hemingway heading for the Italian front, only to receive e-mail to the effect that his devoted nurse might not love him anymore. Wouldn't his prose have limped then? That fine, athletic style, in a sling and with a crutch!"

"I don't think Hem met the nurse till he was wounded, Benny," Wipp said.

"But you get the point."

"But suppose she wants to test you. To see if you're tough."

"How do you mean?"

"She's seen you in fine form with an alien once, right? So she tightens the screws. Makes it a challenge to you. See if you still cut a good figure."

The words sounded plausible. "So I have to convince her I've withstood being unmanned, is that it? Presuming I do, that is."

"Benny," he said. "Consider. You are head of this expedition to Hock's farm, yes?"

"Yes!"

"Consider, then. Doesn't it happen that news-people sometimes find themselves in a position requiring action? Sometimes one must step in, abandon objectivity, and take center stage—because no one else is there to take events in hand, right?"

"Wipp, you inspire me. I should be one, in such a situation, you're saying?"

"The opportunity may arise," Wipp said. "So what I think, Benny, is that if

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we can get a holo of you on the front screen of this Special Edition, engaged in the fearless defense of Mother Earth and Farmer Hock, then A. Jones will lack any reason to question your stalwart nature."

"Stalwart! Wipp, with you at my side—"

"At your side? I forgot to mention my blind."

"Blind?"

"I carry it around for bird photos. I'll have to use it here. Otherwise the aliens might attack—approach, that is—me, instead of you. If they approached me, how could I catch a holo of you defending Mother Earth?"

With that we swung off the road and under the sign of Hock's Hoggery. The addenda scrawled beneath those large letters—bits of levity such as, "Knowledge is power," which I recognized as Bacon—failed to lift my heart, however, as the vision danced before my eyes of one Benny Fogg confronting the alien horde in a solitary way, so solitary that it might be characterized as being very, very alone.

"If we may ask a few questions," Wippett said to Farmer and Mrs. Hock, who stood one behind the other at the door of the farmhouse, being of proportions unsuited to standing side-by-side in any confined space. "It might help us out."

"What kind of questions?" Farmer Hock's round face had such a rubescent flush to it I suspected he perched on the edge of explosion at, say, someone who happened to rap at his door with firm, reportorial fist.

"Well, we're here to look into this situation—"

"I want them out!"

"We're reporters, sir."

"Out! Now! I don't care who you are!"

I remembered Wipp's injunction to welcome any opportunities for heroism, and said, with hope within me, "Well, Mr. Hock, we'll do what we can. I notice you don't seem to have suffered any violence from them, at least."

"No violence! How about being knocked out from behind!"

"You said it was gas, dearest," Mrs. Hock said. She looked much like the farmer, with the same roundness of face and body, and even similar overalls, although of a daintier cut and design, being brightly floral. In personality, however, she seemed much the sweeter.

"All right, they gassed me!" Entering a worked-up state evidently provoked huffs and heefs from Farmer Hock, who was taking on the appearance of a steam-driven tractor of yore, regularly venting and gnashing and in general looking intimidating. "Gassed me! Yes! And they didn't do it once, they've done it every time I've wandered into that pen! And I'd just dumped fresh slop loaded with fifty buckets of rotting potatoes and apples in the trough, so it's just crying out for some pigs. But every time I get near, to let them in—*wisst!*—they gas me, and I wake up naked! First pen there, beyond the shade. Aw-huff. Heef! Naked!"

"Naked?" I shaped a picture of the enemy. If they gassed first, answered

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questions later, it could lead to an awkward interview.

"Naked as a pig, that's how they leave me. They've probably taken twenty sets of suspenders in two days."

"They want your clothes?"

"Hell knows what they want. They lurk around back there, aw-huff, waiting for me. They take my clothes and wear them!"

I took this in with a twinge of panic. I had hoped for guidance from the farmer. Farmers, in general, know how to deal with vegetables. I had expected a tip or two. Thus aided, I would have approached the aliens with the kind of bravery and fortitude that has characterized the Fogg line since grandpa, old Beezer Fogg, earned the Purple Heart at the Bulge.

The farmer a-hoofed. "It's no way to treat a man."

"Well, at least there's room in the closet, now," said Mrs. Hock.

Around the house we obtained a view of the sheds. The two largest met by means of a tin arch, which created a sheltered place that gave shade against such days as this. To the left we saw a few rotund creatures. Some grubbed around the fence or thrust their heads ear-deep in muck, grunting their contentment.

Through the arch, in the sunlight beyond, marched a row of figures I recognized by the antennae and overalls. They moved in formation, bob-bobbing and occasionally hooting.

"It all comes clear, Wipp," I said. "Here's the plan. I'll go through the arch, but I'll wait a moment there while you go and find a good vantage point—say, the top of that shed. Look, there's a ladder. The trough Hock mentioned must be on the other side."

"And the purpose for being on the shed?"

"Station yourself there, in your blind." I prided myself for remembering to include it. "Then set out a remote, to hover in midair, to get shots of me approaching the aliens. You can shoot the rest from your position up there. It'll be great, Wipp."

"And what exactly are you going to do?"

"I'm going to use my big flapper. It's what I'm best at, Wipp. I've just decided that. And I figure I have a simple message to deliver to these aliens. I've reviewed the facts of the case and see that now. What did our poor alien Extwizl want, after all? Our leader! Do we have one? No! At least I don't think so, unless you count Mr. Wire, and who would travel across interstellar space to find him? These guys must have a simplistic political philosophy, and think everyone's like peas in a pod. So all I have to do is go up to them and say *I'm* the leader."

"You?"

"Why not? That'll buy me time to reason with them, as I did with Extwizl."

"And they'll all commit suicide? But you don't even know why Extwizl did it!"

"I'm sure to hit on it. Just talking seemed to wilt Extwizl a bit. And if they're pliable, they might do anything. It's like you can make a limp stalk of celery do all kinds of table

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tricks a fresh one won't. Maybe they'll just leave. But that's the plan, Snolligan! Let's to it!"

"Now, Benny, if I may suggest—"

"No, Wipp. As you said, I'm head of this expedition. I'm off. I'll give you a few minutes to get positioned. Then I'll make my move. Let's go!"

I found my post, settled in, and eyed the aliens. This affair looked easy. The hardest part, I decided, would be taking the deep breath required for my lengthy disquisition, being bathed as I was by such delicate air as surrounds pig farms.

Steeling myself, I stepped into the shade beneath the arch. I prepared to take in a gulp of air for my assault. I would sweep upon them, the Leader of Mother Earth, with such a rapid-fire, full-force word-volley that these vagrant vegetables could hardly help being disarmed.

I took in the prodigious breath, only to find that what I gulped fell short in the farm-country, *eau-de-grange* department. I whiffed in an intoxicating cocktail that included compounds foreign to the customary oxygen-nitrogen, so that my mind, full as it was moments before, emptied to become as blank as that old bane of newspaper writers—the blank page—which intimidated poor hacks back in the age before the horror of the endless scroll of the blank screen, which is a terror to even the most talented of the verbally ept.

"But I am the leader!" I managed that even as I reeled. "I am the leader!"

I saw the vegetable fiends that had crouched in wait for me, on each side of the shaded space. They sprayed me again with whatever perfume they preferred in visitors. I felt faint. I was scrolling into the Page Down of unconsciousness.

I was going, going, going, as they say; and try as I might to say something about an experience that lacked any qualities except the absence of qualities, I must rest my description on the good Anglo Saxon word that typically follows going, going, and going:

Gone.

Not long gone, however. It seemed only a second passed.

Yet I faced evidence to the contrary.

I judged this not from the absence of the vegetable aliens, who had bobbed off and were hooting somewhere to the right.

I judged this from the absence of something else.

My clothes.

My clothes had appropriated my former state of consciousness: gone.

I picked myself up and stared down in disbelief. You may not think the sight of your own skin shocking. Try it at an unexpected moment, then. Knock yourself out by surprise, have friends strip you, and then rouse yourself in a dim, head-swimming kind of way. Then take full gander at your skin, which you will find stretches from crown to corn, an unremovable dermal underwear covering everything except a few visible bones in the mouth, which escape by the skin of their teeth. The skin's very prevalence, its very overall-ness, its quality

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of being so tellingly and acutely *you* will call forth an ounce of embarrassment per pound of flesh. If you have darker hue of skin consider the luck of your situation. If, like me, however, you have too little pigment, you will find yourself displaying not only a full stretch of intimacy, but also its blood-carrying capacity at overload, until you become a billboard of emotion, a full-frontal affair, at which point we say of your composure that which we have said already of other aspects of the situation: gone.

Thus I found myself. I bolted.

Even after the shock of having Sun strike every plane, bulge, and protuberance of skin and reflect it up at the unsuspecting eye, I remained in control during my retreat, giving my flying limbs a sensible command, viz., to find clothes. I perceived where the nearest covering might be: atop the neighboring pig shed. I would don Wippett's bird-blind.

I zipped to the pen and leapt the low fence over which, beyond a stretch of dusty, hoof-beaten earth, I saw the ladder that led to the shed's top.

At that moment I became a believer in mental teleportation.

Normally I dismiss those powers ranked among the "paranormal" unless scads of careful experiments point toward the incontrovertibility of the phenomenon. I like the falsifiable test, and the steady, slow, thick-brained kind of study that unfortunately your normal psychic can see right through.

In this instance, however, I believed instantly.

For I had forgotten about the pigs.

I hung midair, just past the fence over which I had gaily swung myself, naked, and saw, below me, a mass of pigs, exactly more or less where I was to land. Around them stood more, scattered in that haphazard way of pigs.

You might think I hold something against jiggly, fat things on hooves. Not so. At the moment, however, they startled me, and I startled them. They saw me loom above them, a naked man, and squealed. I saw them below me, and I squealed likewise, because, with so many nerves exposed to open air, I was in a state far from the Fogg norm of sangfroid and phlegm. Truthfully, I suspect the high pitch, intensity, and not very yippy nature of my utterance would have made it difficult to distinguish my squeal from the properly executed scream. I made a full-throated effort of which any dedicated screamer would have felt proud.

The concordance of human and pig squeals—we are said to be closely related, biologists tell us, which may help illuminate this strange situation—may have created a harmonic resonance. The sudden eruption of movement among the massed pigs may have exerted an effect, as well: undoubtedly they moved into a subconscious mandala that ripened the situation's potential for psychic occurrence.

Whatever the case, I found myself one instant hovering startled over a congress of equally startled pigs, and, in the next, scrambling up the ladder to the top of the shed, my feet never

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once having touched soil of pen. I had moved a good twenty-five feet, and had no memory of doing so. I accept without question that instantaneous teleportation is a done and accomplished thing.

In my haste up the ladder I failed to notice the heat in the wood, imparted by the blazing Sun. I then pranced onto the corrugated metal of the roof, barefoot—and continued to prance, alarmed at the earthly version of Protestant Hell I discovered there, high above the pig-yard where I had engaged in ungodly psychic transport. Moreover the steel roof danced with me, coming unmoored with every booming footfall—what little booming could be heard above the sizzling of soles on metal. To make things worse, Wippett had fled. He stood nowhere in sight. His bird-blind likewise. I pranced in perplexity. I put down one gingery, reluctant foot after the next. That next, unfortunately, unbalanced a section of roof. I felt myself go down. The next moment, I felt a tremendous *thwack* in my rear as the other end of the sheet-metal swung up and biffed me with a sizzler, sending me up and over the side.

I wish I could again say I proved the efficacy of psychic transport. However, as I hung once again midair, I did see my salvation. Beneath me I saw a trough of water, to catch and cool me.

I fell without a splash, which gave me a clue as to my mistaken perceptions.

The trough being deep, I submerged fully before gathering myself and pushing up for air. I opened my mouth and, in a rare and brief vacation from being self-collected, I bellowed with a volume that would have done justice to the elephantically voiced Mr. Wire himself. I pulled rotten apples and potatoes from my eye sockets and nostrils, jumped from the morass, and high-tailed it for the farmhouse, the pigs rioting clamorously over what must have seemed a terrible tease, me going past so quickly and smelling so exquisitely edible.

To avoid painful exploration of fresh wounds, I will note simply that following an outdoors hose bath, the judicious application of a large leaf from the burr oak, and a perplexing moment in a voluminous closet, I emerged from the farmhouse in the ruling Hock style. Except that the Hocks had run out of his overalls, which left me the choice of hers.

I emerged at a run, screaming, "Wippett!"

I had no knowledge of the whereabouts of the man. For all I knew, the vegetables had absconded with him to some distant star. If so, there would be hell to pay at the *Holograph*. If not, likewise. For I had managed neither the interview nor the heroic gesture, which meant my pork was cooked with A. Jones, for I had failed to appease the unappeasable Wire. The Special Edition was hamstrung. The pig of doom had squealed.

As I flung myself out the farmhouse I tumbled into Wipp.

He picked himself back up and stood calmly, a stalk of wheatgrass in his mouth—the picture of a hayseed.

"Wipp," I managed. "You're OK!"

He nodded at my outfit. "You're

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OK, too."

"Where were you?" I cried. "You weren't on the roof!"

"It looked on the unsteady side. I went around the other way."

"But when they saw you, didn't they—?"

He shook his head. "I guess you didn't understand them well enough, Benny. I gave it a little thought before I went near. You see, they're vegetables. You know that. Moreover they're hive-like. You might think of ants, or bees. You saw how they all moved together, in formation."

"Line dancing, I thought."

"It's a function of their being so interconnected. Must be their antennae. They radio-broadcast or something to each other. Social plants, you know."

"Anti-social enough to gas me. Even after I told them I was the leader."

"I think they already knew you weren't. That interconnectedness, you know. That one Extwizl told the rest, so of course they didn't believe you. But that's just as well, because if they'd thought you *were* the leader, you wouldn't have been too happy. The Extols want our queen, actually."

"Extwizls? They all called themselves that? But wait a minute. Queen?"

"Group-identity, Benny. These are hive plants. They're all worker-plants, or drone-plants, whatever you want to call them. They have some individuality, but mostly they're subservient to the hive. Or to their king, in this case."

I considered this, and gave my reasoned opinion, "Ah," I said.

"They're an interstellar species, Benny, spread out over a godawful number of worlds. They set up colonies here and there. But that means the kings have to do a lot of traveling, to ferry pollen. It's your usual act of insuring genetic variability in the species, just on a galactic scale."

"But if this was all a chummy, perpetuation-of-the-species type social visit, then why did Extwizl draw his departicularizer?"

"That was a spore-bearer," said Wippett. "Sure, it works like a gun, in case they have to do a run on cell chambers and force the pollen in. The politics of sex—well, it's pretty screwy in our own species, too. But anyway, that departicularizer was—"

"I got it," I said, the light switching on. "I thought it was a pistol, but really it was a stamen."

"And that Extwizl," Wipp said, "was just an expendable pollen-bearer. You weren't reacting right, and the plants here were beginning to wonder if they hadn't landed on another king-hive instead of a queen-hive. So they gave him a cease-and-desist order. They were practicing their military formations here, and taking on local disguise as they could, in case they were getting into a territorial scuffle."

"You know, Wipp, I still don't know how you kept from getting gassed. You're holding out on me."

I detected a certain hesitancy as he said, "Well, as I said, or maybe I didn't, I saw you get gassed, and thought maybe I'd get around it somehow. Because what did they want? They seemed to want your clothes. So I just went buck-naked, and they weren't

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bothered a bit and let me go up and talk to them."

"Naked? You?"

"Might have a little sunburn in odd places. But don't you want to know why they left?"

"They left!"

"They did. I convinced them it was no use, this effort of theirs. Not on this planet. We're animals, and we're individuals. We do it individually. I had to draw pictures in the sand, because after all I only had me, naked, for a sample. I didn't have, say, Addy Jones along."

"Wipp!"

"Well, they looked at my pictures. Seems they recognized the images of man and woman from an old metal plate their king picked up at some interstellar swap-shop. Plus it helped them understand what you'd told that first Extwizl. When I pointed out that one, the man, was Farmer Hock, and the other, the woman, was Mrs. Hock, why, they all understood. Turns out one of those pairs of overalls—"

"No wonder Farmer Hock was so mad."

"So, anyway, they believed me, and they left," said Wippett. "It was kind of like spoiling someone's date."

We headed for the *Holograph* full of confidence. I sent story and sidebars ahead, while Wipp told me he sent some stunner pics. I felt the kind of triumph my Grandpa Beezer must have felt after tripping over his shoelaces in the Ardennes and shooting himself in the foot, while within spitting distance of enemy fire: the triumph of going home to medals.

Then a vision swam into my mind.

"Wipp," I said. "What exactly did you find in that holo-cam of yours? I mean, what were these stunner pics you sent Wire?"

"Oh, I found a few good ones," he said. He pointedly gazed out his side window, even while driving.

"Nothing—revealing, I suppose?"

"Oh, I suppose not."

"Nothing that might strike a—say, a personal note? Nothing to which we might attach the sensitive adjective of 'naked'?"

"Oh, no, Benny. No skin. Not a bit."

I mean it as a tribute to Wippett Snolligan when I say I trusted him. Since he said the tender adjective could not be attached, I shelved fears of said adj. with confidence.

"Fogg!" called a voice from the newsroom. "Snolligan!"

Jerome H. Wire's voice bellowed out genially and nearly within normal decibels.

There, on the large screen to one side of the newsroom, where blow-ups of the latest edition were projected for final proofing, loomed the lead screen of our latest, the Special, the issue for which we two, Fogg and Snolligan, had risked necks. And there—

There, on the wall, just below a huge two-word headline that burst out:

"DESPERATE MEASURES!"

There, there, in the middle where even the most accidentally slipping eye, meandering aimlessly across the page, would stumble upon it:

There, *there*, even *I* saw that *there* was the picture of one re-

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porter of personal note.

"Wippett!" I squeaked.

"You aren't naked," he said.

"Not in the exactly naked sense, no. But underneath! I'm wholly naked there!"

"Not so as you'd notice."

Jerome Wire stood beaming at this uncomfortable revelation flaring upon the wall. "Fogg and Snolligan, you guys are geniuses! This will sell! We've got an edition with 'Special' all over it!"

"But boss," I said, "that's *me* up there."

"No modesty now, Fogg." He smiled and waved his hand over the image. Knowledge dawned on me as to what exactly Wippett had sent: an audio-holo. "As Wipp says down here in the caption, the aliens wouldn't have gone, despite good reason, if you hadn't resorted to this desperate scare tactic! Way to think, Fogg. I'll have to stop saying your brains live up to your name!"

At the wave of his hand, the monster out of the trough-muck, with rotten-apple eyes and a glistening skin of festering, oil-streaked goop, opened what seemed to be a mouth and bellowed—*Aaoooough!*—with a moan and a sound of deep-seated disgust and anger. It scared the bazeezus out of me, even!

Wire snapped his fingers and walked off with contentment in his saunter.

"Pretty frigging snappy, guys," yelled Jodi.

"Hey, not bad," said Adelaide.

I brought myself up and pulled my collar.

"Well," I said. "I guess I don't look so bad, do I? I'd almost call it—"

"Heroic," Wipp said, nodding. "Yes. I'd say so."

"Heroic? Maybe," Adelaide said. "But don't you think they'd look better on someone else?"

By the time I realized she meant Mrs. Hock's floral overalls, Addy had turned and gone.

"Well, Fogg," said Wippett Snolligan, patting my back, "the Universe is a pretty strange place, isn't it?" ■

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John K. Gibbons

VOICE OF THE PEOPLE

In desperate circumstances, you must use the most powerful tools at your disposal—but that can be a scary thing.

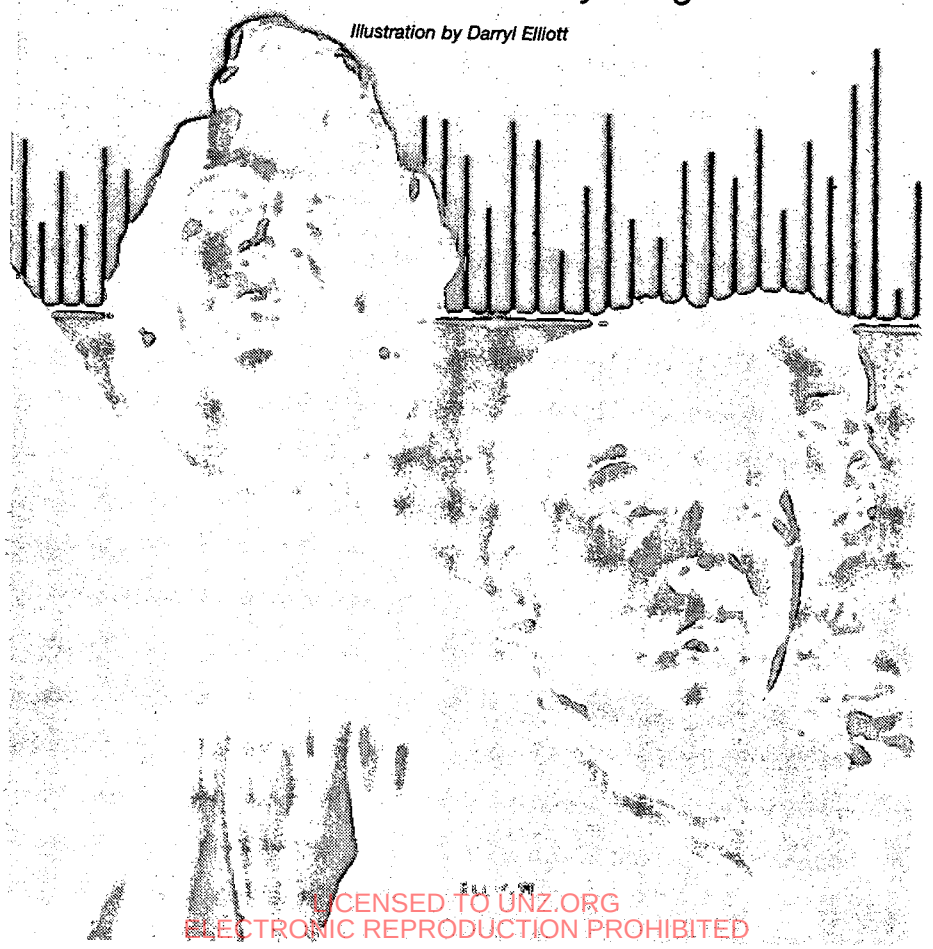

Illustration by Darryl Elliott

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The VTOL Guard transport filled Stan Martell with dread. This stub-winged stark killing machine had invaded his airport, his arcology—and at his request. War and ruin, desolation and destruction: the images had driven him, but they had been distant, abstract . . . until now.

There Siemens was, at the aircraft's door. He shaded his eyes against the Sun's glare, then strode down the steps with the arrogance of a conquistador claiming a new land.

How could the bastard look so young? Jet-black hair—what was left of Martell's own had been gray for years, and his carefully trimmed beard was completely white.

"General Siemens, good to see you again."

"It's *Rick,* Stan. We've known each other long enough for that." Siemens grasped his outstretched arm. "What the hell's with this dipshit airport?"

Martell laughed. "Maybe you can do something about that if we get you elected senator. I thought you'd retired? The Guard still seems to look out after you."

"The Osprey?" He waved at the attack transport behind him. "There're a few perks of being an elder statesman. You've done right well, too, building yourself this city in a bottle."

"Martco's building this place. I have my own company, Synergetics."

"Old son, you were talking about arcologies in college. It is Martco, and you are Martell."

"There are a few perks of being the founder's son." Trust Siemens to find a raw nerve. Martell had dreamed of arcologies back in the seventies because they were beautiful and efficient. Now at the turn of the century he had the chance to build one, but only because the nation's cities were drowning in sewage and blood.

Martell led the way to the terminal. Within, the air was blessedly cooler: the dry 80 degrees that Travis Towers kept on a summer day. He was blind to the familiar scene, his mind on the tasks ahead, his eyes on the general.

Siemens had been a cocky bastard even back at UT, his self-confidence unshaken by the Vietnamese POW camp. In his late fifties, he glowed with power, a choreographed balance of energies. The media coverage of his reforged National Guard—the brutal suppression of LA gangs, pitched battles with Philadelphia drug dealers, fanatic celebrations at the Pittsburgh rally—all had mentioned the Guard's fierce loyalty to Siemens, but hadn't conveyed the sheer force of his personality.

Dare he vault this man to even higher power? Hundreds of millions of lives at stake: but those were *projections.* Yes, the threats were developing with terrible accuracy. The Islamic Federation now had as much megatonnage as Russia, and dozens of countries had the bomb. But how could any man, any group, make such decisions for the country—for the whole human race?

Not to decide, is to decide by default; muddling through is for morons. *Hell.* He had sixteen hours, to settle his own doubts and to convince Siemens. The plan was to take the general up on the mountain tonight

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and show him the world; he wanted to be damn sure where they both stood before it got that far.

To Martell, the War Room was the heart of Synergetics. Recessed lights turned on as they entered; a dark mahogany conference table ran the length of the room. Martell gestured Siemens toward a seat, then opened a liquor cabinet. "Scotch?"

Receiving a nod, Martell poured for them both, then returned to the table. "That whole wall is a video screen, for data displays or virtual conference. The other side, behind us, overlooks Ops. Medea, pull back the drapes from the Ops window."

With a faint whir, the heavy curtains drew to the sides. Siemens froze, glass halfway to his lips. "Is the computer always listening when you're in here?"

Martell smiled. Interesting, what gave Siemens pause and what he took in stride. "You get used to it." Below, four rows of consoles filled a large room. Operators wearing headsets and control gloves occupied half the seats. A large display on the far wall showed a map of Houston and an abstract, weaving pattern of colors. "Medea, how's the poll going?"

"We have 213 calls in progress. Over 3,000 have been completed so far today." Did Siemens recognize that warm contralto? He probably hadn't heard Helen's voice in years, but she would be at the reception tonight. "Completions are nominal, at 86 percent of connections."

"You keep saying Medea," Siemens said. "I thought it was the Argos project."

Martell shrugged. "We needed a more personal name for the AI itself."

Siemens turned back to the balcony window and frowned. "A dozen operators and two hundred calls? Are they making the calls—or Medea?"

Martell looked up at a video camera mounted above the screen on the opposite wall; he thought of Medea as "being" there. "Can you handle that question?"

"I think so, Dr. Martell. Is this General Siemens?"

"Yes, Medea, General Richard Siemens." She knew that—she kept his schedule, and had pictures of Siemens on file. Medea was getting feisty about manners as she learned more about them.

"General, it takes a large part of my capacity to handle a conversation such as this one. A telephone poll is simpler. I dial the call and start a standard script. If the party answers with a clear voice, and stays within the range of replies I'm expecting, I can handle a whole call with a limited agent, a small subset of my capacity."

"And if they don't?"

"That triggers a delaying routine and plays the response back for an operator. The operator classifies the response, and suggests how to continue the call, or abort it."

"But you *could* figure that out yourself?" Siemens was leaning forward, staring at the camera as Martell had earlier.

"Yes, but not for that many calls at once," said Medea. "Neither could so few operators actually talk to so many callers at once. It's all a matter of making the best use of resources."

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Siemens relaxed and looked back at Martell. "Isn't everything? Impressive. You set up all this for polling?"

"Polls, market research, telephone sales, election day get-out-the-vote." Trends and patterns spotted from this room, and mathematical modeling of them, had germinated into sociodynamics. Here they had analyzed the deadly instability of the post-Cold War world, and formulated the plans leading to this meeting. "It can be a testbed, a simulator for any man-machine network. Synergetics is contracting a disaster plan for California, everything from engineering and logistics to panic control."

"That must be a circus. You could run a war from up here."

Martell grasped his arm, stared into his steely eyes. "This is a war." Nor am I out of't, he thought to himself. "Just because there are no guns and bullets *yet,* don't think it's any less important." Martell released Siemens's arm and turned to look out over the consoles below. "The fate of the country, of the world, depends more on the politics of the next few years, than on any war we ever fought."

The reception glittered with champagne fountains and petit fours, politicians and businessmen. A jazz quartet played at one end of the hall. This kind of set-piece of politics gave old pols and newcomers a chance to sniff each other over.

"General Siemens, have you met Secretary of State Samuel Pauli?"

"I don't believe I have." Siemens looked bemused. "Please excuse me, Secretary Pauli. I didn't know Texas had a secretary of state—how many embassies have you got?"

Pauli laughed deeply, his silver mane of hair shaking. "None at the moment, General. My job is licenses and registrations, corporate charters and boring stuff like that."

"Secretary Pauli is too modest," Martell said. "His office also oversees all elections in the state. A good man to know."

"General, you served in the Gulf War," said Pauli. "What do you think of the Saudis kicking out our troops last week?"

"Fools," said Siemens, spitting the word. "They say our planes and soldiers were a provocation to the Islamic Federation, and that they'll get along fine once we're out of the way. Wait a year, and the Caliph will roll right over them."

Martell kept quiet. His own projections put the even money on six months.

A few congressmen and oil barons later, Helen Matsuto strolled up. Her long red hair, tied with a silver filigree, fell across one shoulder of her deep blue gown. Martell kissed her cheek, then turned to Siemens. "Rick, you remember Helen, don't you?"

"I *did* introduce you two, fool that I was. You're as beautiful as I remember, Helen." Siemens took her hand and nodded, almost a bow, then gave a start as he noticed her wedding ring. "Stan, you've been rude, to your wife and to me! Why didn't we get together earlier?"

Martell, suddenly aware of his arm around Helen's waist, stepped back awkwardly. "I'll plead guilty to rude-

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ness, Rick, but Helen is married to Tony Matsuto, my top mathematician."

"I beg your pardon," said Siemens. He raised an eyebrow, more inquisitive than apologetic.

Helen laughed. "Let's sit down and talk about might-have-beens, Rick. And I'll fill you in on twenty years of gossip." She leaned back into Martell's arm. "Stan's a dear, but he's impossible to live with. The word *intensity* scarcely begins to describe him."

"He seemed comfortable enough on the ski slopes earlier."

"In virtual? Maybe so. You should see him on the racquetball court. He plays racquetball like the Germans played World War II."

Martell felt a touch at his elbow. It was the drummer from the jazz group. "Get your clarinet, Stan. You were damn good that night in Dallas."

"I'm three years out of practice, Jimbo." Martell laughed as he steered the musician back toward the bandstand, but the pique must have shown on his face. Helen looked away pointedly, and Siemens's gaze bored in. "I *was* good enough to play in public, Rick. Picked it up quickly, but topped out quickly, too. No spark, no hint of musical genius."

"You can enjoy playing without genius," said Helen.

"Damned if I'll bust my butt to be mediocre." This argument was a ritual. "There's Speaker Harris. You should definitely meet him, the second most powerful official in Texas."

"*Second* most powerful?" asked Siemens. "I thought the lieutenant governor had more power than the speaker."

"Yes, of course." Martell waved at Harris. "Oh, you were thinking of the governor? Lord, no, he's a distant third."

Siemens strolled along the glass that formed one wall of Martell's dimly lit study. In the day, it would reveal a panorama of the Texas hill country, San Marcos a few miles south and San Antonio in the distance. Even with the lights low, the wall was a mirror at night. The general reached the far wall and stopped in front of a large painting. "Is this a Dali? The style looks like him, but I don't recognize the piece."

Martell joined him. "The work of an amateur, imitating the master." He reached up to touch the canvas, brushing the tips of his fingers against the waterfall in the upper left, the washerwomen by the stones in the foreground, the distant town at the river's mouth. "*Riverrun: the Washers at the Ford.* Can you make out the invisible giant in the landscape?"

Siemens cocked his head to the side. "I'm impressed. I didn't know you painted."

"I don't," Martell said, suppressing an old irritation. "This piece took three years and far too much of my time." And derivative as hell, for all that work.

Siemens waved at the photographs and drawings on the other walls. "Did you do the rest of these?"

"Mostly. I swiped that drawing of the LBJ library as the Parthenon; remind me to tell you the story some day."

Martell had thought he kept the

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sourness out of his voice, but Siemens gazed at him with narrowed eyes.

"You're too hard on yourself, Stan. You see this room as a reminder of your shortcomings, don't you? You don't have to be the best in the world at everything you do."

"Sure." Siemens's insight was unnerving. Most visitors read the room backwards, as a boast of his talents. "Like you were satisfied to be a mediocre pilot."

"I trained for thousands of hours before I could claim even mediocrity. You're a world-class researcher, Stan. I know what a Citation Index is, and I know you wrote that stuff without slave-labor graduate students."

"Ancient history." Martell scowled. "I don't write papers these days, I shuffle them."

"Not the way I hear it. 'The leadership of Oppenheimer, and the intuition of Niels Bohr.' You didn't develop Medea by shuffling paper. If you want a hobby, too, pick something and stick to it. Life isn't *all* competition." Siemens turned to the fireplace. "What about that stone carving?"

"That's a Hindu *agni,* three centuries old."

"That's right, you were reading Eastern stuff back in college. You found something that matters to you?"

"I found beauty, and peace." Martell shrugged. "And contradictions. Parts of it speak to me, though, in a way that nothing else ever has."

Siemens dropped into a black leather chair. "Speak to me about the Senate. You proved you know the movers and shakers in Texas politics. What else have you got to say?"

The classic Siemens, switching tracks at full speed. "It's not a question of knowing them, Rick. You could get in those doors without help." Siemens nodded; that had been his point. "We can give you a network of favors and inside dirt going back decades. Dad was greasing palms and providing 'volunteer' campaign battalions before I was born. More lately, Synergetics' hi-tech edge has made the difference in a lot of elections."

Siemens leaned back in the chair, bushy eyebrows drawn low over narrowed eyes. "So . . . why me? And what's in it for you?"

The payoff. Martell stood, gathering his thoughts, his eyes wandering again across *Riverrun.* The projections this week had been bloodier than ever. Japan practically admitted they were building nuclear weapons, and the Middle East marched relentlessly towards the chasm.

The only other prospect Martell's Planners had found, the Urban Liberation Front leader, would be much harder to get into power. With Siemens, getting him out after the crisis might be the real challenge. Of course, they could sit back and do nothing, let the horrors unfold. Keep their own hands unbloodied, their own consciences clear.

How could inaction be the moral high ground? With hundreds of millions of lives at stake? Not to decide is to decide. OK, Siemens, you're the one.

"General . . . Rick, why do you think we started the Argos project?"

Siemens raised one brow. "To cre-

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ate an artificial intelligence, right?"

"No, that's a side goal, almost a cover." Martell leaned forward, reached out with both hands. "We wanted to leap-frog computing technology, to bring immense processing power to bear against problems too intractable to be attempted before."

"Which are?" Siemens leaned his head to the side, waved a hand in invitation.

"Chaos. Catastrophe. The world going to hell in a handbasket."

Martell sketched his techniques, and the concepts of chaos and Thom's catastrophe theory. In fields from physics to geology, catastrophe meant a sudden shift in otherwise smooth behavior. A chaotic system was extremely sensitive to tiny differences in initial conditions. In a now-classic metaphor, the beat of a butterfly's wing in Brazil could determine the weather a year later in Paris.

Siemens sipped his Scotch as he listened. "So what have you got—psychohistory, like that sci-fi writer?" he asked. "You can figure out which butterfly to watch—maybe clip its wings?"

"No, that was von Neuman's mistake. He thought computers would make weather control possible. Any system so sensitive, would be that much easier to control. Asimov's psychohistory was like that, sculpting the course of thousands of years with elegant adjustments." Martell was pacing along the windows. He stopped, shook his head. "It won't work. The lesson of chaos theory is that you *cannot* get a total, perfect description of such a system, that you couldn't make calculations accurate enough to project changes, anyway."

"Stan, you're going round in circles." Siemens frowned darkly. "You say you've predicted disasters, then you tell me predictions are impossible."

Martell stood facing the glass, staring at his reflection. "I want you to know the limits of our technique. It's not some crystal ball. We can't tell you where there are going to be riots five years from today, or what day war is going to break out between Zambia and Mozambique, any more than we can tell you where tornadoes are going to strike."

"So what *can* you say—and who is 'we'?"

"Chaos and catastrophe, damnation and ruin." Martell spun around, propped his foot on an Italian leather chair. "We—the core group within Synergetics; you might call us the Planners—we can see the large, like climatic shift, and the short-term, like tomorrow's high and low. We can see structures lurking in the haze of uncertainty, catastrophic transitions that suck in world-lines. Patterns: the fractal mathematics underlying chaos is full of shapes that recur at different scales. Even when we can't predict them, we can recognize them as they start, and know we're in for a hell of a ride."

"And these disasters you see?"

Martell sat down facing Siemens. "Rick, you've been in the military since Vietnam. Why even think about politics, now?"

Siemens stared at him for a moment before answering. "Frustration, anger.

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Politicians are frittering away everything I was fighting for. Crime and poverty, riots, a moribund economy; people don't give a damn about education or work. We're not a superpower anymore, we're not competitive—we're hardly even a nation, just a collection of squabbling tribes."

"That's why we're interested in you. You understand the problems. Your New Cities work with the Guard is one of the few positive steps in the last decade. But it's not enough. We're headed for either total collapse—starvation, plague, and riots—or a police state." And Siemens's Guard looked to be the new Gestapo; he didn't understand the tiger he was riding.

"Your math paints it grimmer than my intuition, but we're singing from the same hymnbook."

"That's just for starters," Martell said, shaking his head. "On top of that, war. Too many old grudges, too few resources. Russians, Chinese, Germans, Japanese, the Islamic Federation—and us on the sidelines, wishing the world would go away. I can't say who'll start it, or who'll be on which side, but everybody will get sucked in. And nukes *will* be used."

"Balderdash, Stan. The cold war is over, Armageddon has been canceled."

"Rick, too many countries have the bomb, too many crazies have fingers on the button. The stability is gone, the threat still here. *You* know how much of the old Soviet arsenal is unaccounted for."

Siemens nodded grudgingly. "Still, what do you want from me? A figurehead, a mouthpiece for your analytical solutions?"

"Hell, no," Martell said. "If you were weak enough for us to dominate, you wouldn't do any good. To have any chance at all, we've got to have stronger leadership than we've had in decades." A small part of the plan, but true enough, and it played to Siemens's ego. "We want someone in power who will listen to us. The decisions would be yours."

"If history is the kind of clockwork that you can predict, how can any one man, any leader make a difference?"

"No, no!" Martell leaned forward. "History is *not* clockwork. Most human affairs are chaotic, and the actions of an individual can make an enormous, unpredictable difference. One man, Gorbachev, brought down a huge imperial power, and destroyed its ideology. But individuals work within institutions, subject to social forces. Those structures and forces have coalesced to form iron bars. *All* the outcomes are disasters."

Martell paused, looked down to see that he was holding his fists clinched in front of him. He opened his palms, beseeching, and went on. "The pork-barrel politics of congress, the bureaucracy, the entrenched interests mesh together to strangle initiative. There's no room for leadership, and a true leader couldn't get elected anyway. But . . . understanding those forces and interactions, we can navigate the shoals, get you into office where you *can* make a difference."

"A senator doesn't have that much power."

Martell laughed. "Rick, if we can't get you to the White House inside of

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six years, we might as well pack up and go home."

God, she was beautiful.

Siemens thrashed in the bed, sweating like a pig. A drink? Hell, that was half the problem.

And she was the rest. Amazing, she bowled him over. Even after hearing her voice from Martell's damn computer, he'd still been blown away.

Totally unprepared—like the first time. The stack of letters when he got back from Nam made him think of her as a kid sister. She'd been in junior high when she first wrote. Reading four years of letters at once, it was hard to keep things straight, to see the woman she'd grown into.

He should never have written back.

Then there she stood, on the porch of that old house back of the co-op. Grinning, holding up her arm with the POW bracelet, his name on it.

Walking next to her, an arm around her. More intimate than sex with some women.

How did she do it? She still had the knack, he'd seen that tonight. Close, sensual pressure, but effortless. Like she was following his lead in a dance, like she could read his mind, their bodies were one.

And in bed. . . .

One night only, and he'd never found the like again.

Did Matsuto know his wife was sleeping with his boss? Sure. If it was that obvious to Siemens after a few minutes seeing them together, her husband had to know.

Siemens rolled over again, chilled now.

Senator Siemens. It had a ring to it, yes. Maybe President Siemens someday. Martell could pull it off if anyone could. He saw the demons at the gate, when most of the country was frothing at the mouth about the wrong things.

"Come to work, come to work, it is better to work than to sleep."

Martell woke painfully, reality grinding in on him with the whining chant of his alarm. Damn Siemens, for suggesting such an early breakfast. Damn him twice, for suckering him into putting away so much liquor.

The smell of coffee greeted him in the guest apartment Siemens had accepted, and led him back to the kitchen. Siemens wasn't there, but a tuneless whistling floated down the hall. The scene on the counter cheered Martell. A towel held the shattered remains of an aspirin bottle, with a hammer next to it. The neck of the bottle was intact, with the childproof cap firmly attached.

"Morning, Stan," Siemens said, coming down the hall. He wore a knee-length English smoking jacket out of Sherlock Holmes. "Grab a cup of joe, have a seat. What's the agenda?"

"Last night was the big picture," Martell said. "I'm open today to follow up with any details you want."

Siemens's steely eyes narrowed slightly. "Plenty of questions, but the decision's made. Count me in. I've been getting ready for this all my life."

Martell lifted his coffee in a silent toast. He should feel exhilarated at this hurdle passed, but the challenges

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ahead weighed too heavily. *Put this megalomaniac in control of the country? Dismantle the checks and balances of due process, to give him even more power?*

The Planners would have to keep control. Siemens was a weapon of last resort, a pawn to be advanced to the proper rank, for use if the dire projections proved correct. If not, they could pull the plug; they could defuse his power up to the last instant, divert his momentum into a churning, harmless frenzy.

Right.

Vishnu and Krishna. Martell set down the mug of coffee and looked at his open palm, half expecting to see the dragon's teeth that he felt weighing so heavily there, but all he saw were beads of sweat.

"Ann Johnson, General. Pleased to meet you, have a seat."

"Pleasure's mine, Ann." Siemens looked Johnson over: tall for a woman, and heavy boned; short gray hair, corporate-looking suit. No diploma in sight, but Martell had mentioned she had an odd degree. Divinity, was it? Photos lined the walls, signed portraits of governors and presidents, Johnson shaking hands with the great and near-great of several continents. "Martell recommends you highly, Ann, but I thought he was going to manage the campaign himself."

"He's a specialist, General: polling and voter ID, and his team has a dynamite E-day get-out-the-vote drill. I'll handle the big picture."

"Call me Rick, Ann."

"Gladly." She turned to a cabinet behind her desk and pulled out a decanter and one glass. "Yours is Scotch, right?"

"Yes, but . . . " Siemens frowned. "I don't care for anything, if you're not drinking."

"Then you'll have a dry time around me." Her voiced dropped an octave, to a passable Lugosi imitation: "I never drink . . . wine." She laughed, and poured him two fingers. "Dad was an alcoholic, and I can't get any interest in the stuff. Take your Scotch, and I'll indulge my own vice."

She pulled open a drawer and drew out a long, thick cigar. She sniffed it, nodded, then cut off the end with a small, oddly shaped knife.

Johnson glanced up, saw him looking at the knife. "It's a mountain oyster knife," she said. "The state Women's Caucus has an oyster bake every year, both kinds of oysters."

She dropped the blade back into the drawer and looked back at him. "Would you prefer a cigar, Rick?"

"I'll stick with the Scotch." Siemens made a mental note to watch his manners—she looked like she knew how to use that knife. "Why don't you go over the mechanics of the campaign."

"Fine. Let's start with what you military folks call a threat assessment. The challenge is the Republican incumbent, Joseph Pryor. Do you have any idea how hard it is to beat a sitting senator?

"Compared to that, the primary should be a cakewalk. Pryor's strength and the rumors of your interest have kept the Democratic field light. There are two candidates al-

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ready in the race. Peter Andrews is mayor of San Antonio, a liberal. The fix is in with him. He doesn't expect to win the nomination and knows he couldn't beat Senator Pryor anyway. He's in the race for name recognition, to run for governor in a few years. . . . "

And the void was without form, and darkness covered the face of the deep. . . .

"Launch another one," Martell said. "Slow the display down, a day per second. That last trajectory was a blur."

A silver point appeared in the blackness. Leaving a pale trace of its path, it danced a drunken tango, skittered to the left, then leaped upwards.

The vertical axis was the key indicator: percentage of voters favoring Siemens. Left to right was economic security, and respect for governmental authority displayed fore and aft. So many variables, no way to show them all. Which variables mattered most? How did they interact?

The Planners' efforts had been directed to projection, to mapping out possible outcomes and probabilities. To actually shape events, to pick an outcome, they needed different tools. They needed to identify opportunities, cusps where they could divert the trajectories to a more desirable path.

"You're wasting your time." Tony Matsuto's voice came from the emptiness. "No one world-line is significant."

"I'm looking for ideas, not answers." Still, Matsuto was right, this was getting nowhere. *Damn*. There had to be some way to organize the morass of information, to visualize and shape this maelstrom. Otherwise this new science was a curse, a prophesy of nuclear hell with no hope or help.

They should be looking at the entire manifold of possible futures, not one arbitrary worldline. "Medea, start with a cluster of points around the current estimate, and follow each world-line. Drop it if it crosses any path. Every five days, generate another cluster around each trajectory that's left."

The snarled silver web vanished, and a ball of bright points appeared. "What's the vertical spread of that cluster?"

"Half a percentage point. The other dimensions are comparable fractions of the respective scales."

"That's good," he said. "Make a second shell of points, twice as wide. Use half that spacing as the test for killing a path." Another ball of stars appeared around the first. "OK, execute."

The points traced ghost-trails in the void. Spreading, shifting, like fireworks in the breeze, or specks drifting in surging water. A few points shot away; others collided, merging.

Five seconds passed, and starbursts of secondary fireworks exploded. Drug-crazed spiders, weaving and knitting. More outliers sped away, more points merged. Another generation of child-trajectories, and another.

The tracery of tangled lines assumed a form—a shape with surfaces and contours. Some true boundaries reflected all paths that approached.

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Other contours leaked trajectories that never returned to the main mass.

"Escape time contours," murmured Matsuto.

"Hmm, yes." Many images of fractal art, like the classic crenellated teardrop of the Mandelbrot Set, were escape time plots. Pump the coordinates of each point through an iterative formula. For some starting points, the cycles stayed within the chaotic region; for others, they "diverged," shooting irrevocably away. The two classes of locations defined the "Mandelbrot sea" and the land around it.

"Yes," Martell continued, "we can map the chaotic region of this 'decision space.' Flesh out the zone that feeds back into itself, and mark the surfaces where trajectories diverge."

"Take the final success axis out," said Matsuto. "Color the surface to show a firm boundary, and use other colors for victory or defeat where trajectories leak out. That lets you use all three visual axes for input variables."

"Right!" said Martell. Siemens's rating for a given point hardly mattered. Much more useful would be to show the boundaries where chaos resolved, where possibilities crystallized into inevitability. If you could push events into a chute where the only exit lines were victories, you were done.

Each point within the displayed shapes represented a set of circumstances—values for the social and economic variables—that could be reached from current conditions. With those "regions" defined, the Planners could find zones to avoid, where trajectories diverged towards defeat for Siemens, as well as regions that coalesced to victory. Find such a region, have Medea back-calculate a valid path from here to there, and then maneuver along that path. Sure, chaotic effects would divert events. But with such a path defined, you could apply constant adjustments and correct for those divergences.

Yes, this was the lever he had been looking for. Tools, weapons to battle chaos. Hinduism saw the Universe as a battleground, not so much between good and evil as between order and chaos. With this analytical method and the hyper-commercial he had in mind for the ad campaign, they might succeed.

"Of *course* we have confidence in your judgment," said Martell. *Damn,* Luke Wilson looked about ready to stomp out of the room. This tailored commercial could be the biggest weapon in the campaign, and they needed Wilson to make it work. Siemens had the luck of it, grasping the reins of destiny rather than shepherding worldlines and pampering egos.

"Then what *are* we doing here?" Luke Wilson looked around the War Room impatiently, nodding at Johnson and Siemens, but glaring at Pete Hoffman, whom Martell had just introduced. "Ann and I can coordinate the ads without . . . taking your time. And I *don't* see a need for another media consultant."

"Hell, I'm no media consultant," said Hoffman. He slouched back in his chair, his hand wandering restlessly across the table as if searching for a beer. "I'm strictly a tech-weenie."

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"I'm sorry if I confused things, Luke." Martell offered his best conciliatory smile. Damn all prima donnas, and double damn conferences and meetings. Martell stole a glance at his watch: ten minutes till noon. It felt like ten till midnight, ten till doomsday. "I worked with Pete on a Cable TV backbone in Dallas; Synergetics did the network design. I have a few questions for him, but let's start with you. You mentioned a 'roadblock' the night before the general election. What's that imply?"

"Standard media term." The chance to patronize calmed Wilson down. "We buy the exact same time-slot on every major network. With all the channels at the same time, we even get the ad-zappers who switch channels when the commercial starts."

Martell leaned forward. Wilson was receptive now; time to plant the idea—delicately. "Tell me, Luke, would you use the same ad on every channel?"

"I expect so. Demographic delineation is possible, by the audience typical of each show, but hardly worth cutting separate versions of the ad."

"But we'll have much more data than that," Martell said. "We'll have individual surveys from millions of households. What if you could pick a version of the ad for each house?"

"If pigs could fly, I wouldn't go out without an umbrella. You're not serious, are you?"

"I'm just asking questions. 'Possible' is for Mr. Hoffman to say. What do you think, Pete?"

"Switching feeds, real-time? Don't see how you could do that. Not for millions of units at once."

"No, I guess you couldn't do that much switching from the central node," said Martell. *Come on, Pete; grab the ball.* He hadn't dared coach Hoffman in detail, the man wasn't a good enough actor. "You've got to have some trick for the pay-per-view shows, though. How many people signed up for that heavyweight championship last month?"

"That doesn't happen all at once. People call in for days, and we download the decoding key to their controller." Hoffman squinted and rubbed his nose. "Say, that might work. Give me a list of who you want to hit with a particular ad, and we could download a program ahead of time to switch their feed. Whatever they tune to, we show them what you pick. Yeah, the chip in the controller is bright enough for that."

"Wait a minute," Siemens said. "Telling different things to different folks boils down to lying about my platform."

"Calm down, Rick," said Johnson, an amused lilt in her voice. "It's a matter of emphasis, talking about the part of your platform those voters want to know about. You don't give the same speech everywhere, you pick it for the audience."

"Yes," said Wilson. "This is the same, but *much* more effective. You'll be saying to those voters what you would in person—but they'll think that you're saying the same thing to the whole state. *Powerful.*" His eyes gleaming now, he turned to Hoffman. "Pete, could these programs be set to

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switch back and forth several times, combine segments as they broadcast? To personalize the ad even more?"

Martell allowed himself a satisfied smile. Hook, line, and sinker. This tailored ad could swing the race several percentage points all by itself. Now that Wilson thought of it as his own idea, he'd do a hell of a job.

The conference room was barely more than a closet, but at least it was quiet. "God, that's a relief," Siemens said. "How can you think with that racket?"

Ann Johnson laughed, a rich contralto, but her eyes showed worry. "Martell has his polls and fancy screens, I keep an ear on the boiler-room chatter. Here's your schedule for tomorrow."

"Speech to the Communication Workers, radio talk show. . . . What's this house-to-house stuff in the afternoon?"

"Canvassing the precincts, a campaign tradition. Knock on doors, smile real big, ask folks for their vote."

"Christ, Ann." Didn't these folks know the importance of time? "There are *millions* of households in this state; what's the point of my stopping by to talk to half a dozen of them?"

"PR, Rick; everything in a campaign is PR." She tossed her head impatiently. "You visit a few houses, the TV crews get footage. Clip in a sound bite, and it adds balance, makes you more personable. Hundreds of thousands see it on the news. Plus it inspires the volunteers out pounding the streets, like when you spend a few minutes in the boiler room."

"Encouraging the troops is something I understand." He should trust her expertise. Staffs won wars, more than generals *or* grunts. "OK, what's wrong? Are the polls that bad?"

"The primary looks fine, and it's too early for me to get worked up over November." Johnson shrugged, but with a grimace of anger. "Yeah, there is something stuck in my craw. It's a rare affliction in politics, an attack of principles. There are hired guns in this business who'd work for the devil himself, but I've got to believe in what I do."

"And you can't believe in me?" Siemens kept a friendly tone, and a self-mocking grin, inviting her to go on. If he couldn't convince her, how could he hope to win the voters?

"It's getting damn hard." She met his gaze steadily. "The Guard always set my teeth on edge. Now that black shopkeeper in Houston claims your thugs beat him up, in a protection racket."

"Ann, that goes against everything I believe." He clinched a fist. "I stopped by Houston last week and liked to rip Colonel Ramirez a new asshole."

Siemens leaned back, then went on. "Problem is, Ramirez is good. He's worked miracles with the gangs, and with the literacy rate in the barrio. We're harnessing deep, primal forces to break the cycle of poverty and violence. Sometimes, dredging those depths, we hit a pocket of something foul. . . ."

He leaned across again, and grasped her arm. "Stay with me. I *need* your idealism, and your talents."

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Johnson stared into his eyes a moment more, then drew back with a shudder. "A month. I'll stay with you through the primary. Don't make me sorry." She searched her pockets until she found her cigar case. "Let's go over speech three again. I've got a few 'new ideas' to work in. . . . "

The chaotic zone sprawled around Martell like some mutant squash with a dozen necks. The yellow showed that there were no exit trajectories. The few patches that weren't yellow were blue: defeat for Siemens. The primary still seemed safe, but the outlook for November was grim.

Martell had prayed for a tool of change, an instrument transcending descriptive projections. These new programs and displays gave him that power. He could project worldlines to find a path, however convoluted, that went where he wanted. Then media manipulation and news management could nudge reality to keep it close to the plan. These were balky tools in a simplistic push toward an objective—immensely more effective as fine tuning to shadow a projected path.

Martell glanced down at his control panel; the panel, the ghostly image of his gloved hand, and the decision contour were the only objects in this reality. This use of the computer interface was a far cry from simulated skiing, but it gave him a feel for the *shape* of the problem he could get no other way. A relief, too, from the gristmill of meetings, analysis, planning. If only he could join Siemens and Johnson in the thick of battle, actually doing something. . . .

The coordinates showed he was on the high end of the economic insecurity spectrum, displaying axes of racial polarization, fear of violence, and resistance to change. He twiddled the national pride slidebar: the surface barely quivered. Nationalism had shot its wad. The primary was locked up, and Siemens and Pryor were so firmly tied to America-first jingoism that it wasn't an issue.

Did the necks mean the zone split up-time? Martell brushed a button, and yellow snakes writhed, some shrinking, some growing. Yes: several pinched off, into independent trajectory sheaths. Interesting. He felt a tug at his beard, from his invisible left hand.

One dancing snake winked out of existence. Another shrank to a ball, skittered across the "violence" axis, and vanished. Martell froze the time, then rotated the viewpoint to swap out fear of change, bringing in time as his vertical axis. Easier to find where those sheaths went if he could see their slope.

The image twisted and turned. All snakes now, the central mass out of sight. The skittering ball stretched into a tube again, bending to horizontal along the "violence" axis, then ending abruptly. Still yellow, though. The trajectories had to go somewhere, they weren't escaping.

Martell scanned up-time, then swapped axes, one after another. The model had used a lot of variables, but the simulation could only display three at a time, plus the color coding for the election results. Swapping axes showed different 3-D slices of

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the decision space.

Picking economic insecurity brought several sheaths back into view. Damn, one tube veered even further negative; he'd thought he was already looking at a worst-case region on that axis. That sheath ended in a bright red bulb. A Siemens landslide, but the economy in ruins.

One path headed steeply up the economic axis, toward the main lobe of the projection, the sick squash he'd started with. Martell tweaked his view to follow it. Yes it plunged right through the main lobe! His pulse quickened, his invisible palms tingled—an unexplored chute, so close to the current locus. Where did it go?

He made the old surface translucent, and the sheath was bright gold within it. A catastrophe transition—trajectories of the main lobe couldn't reach the sheath directly. Even though the regions passed through each other in this projection, they were separated along some other dimension. That's why he hadn't seen this tube earlier: there was no natural path into the tube except the long, convolute route he had followed.

Beyond the trunk, the tube twisted up-violence, then swelled to end in a pale pink bulb. A Siemens victory; not a wide margin, but secure. Interesting, *very* interesting. Martell had explored zones ranging from a Pryor landslide to too close to call. This was a stable chute, assuring victory, and *extremely* close to current estimated conditions.

The long, complex path Martell had traced to this chute was worthless. He'd followed the contour of the chaotic zone; finding a specific trajectory through all those turns, much less guiding reality along such a path, was out of the question. If they could leap across the boundary—somehow jump directly into that chute, so close in this ghostly display. . . .

Martell twisted the virtual controls, spinning the image until he defined the gap between the tube and the main lobe. Distant in two axes: racial polarization and fear of authority. Bizarre. Changes in those directions ought to make Siemens less popular. The numbers on his control panel showed that it would cut the primary margin, but it would secure the general election.

Risky. But so was this whole project.

With the right resources, you could do more than manipulate the news. With money, influence, iron will, and ruthlessness, you could shape history, forge events directly in the foundry of hell.

What would it take, to ramp up racial hatred and suspicion of authority? A riot, bloodily suppressed by Siemens's Guard? The kindling was already in place in Houston. Sparking it would be easy. Grease a few palms, start whispering campaigns of resentment in the ghetto, of fear on the base. Organize a protest, put guns and liquor in the hands of the right hotheads. Martco's security manager had busted heads in union disputes and the like. Loyal as hell, he could be trusted and he'd know what to do.

A twinge of pain knotted Martell's stomach. Shiva's blood, he was planning a riot! He'd been envying the

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others' direct action, feeling guilty and impotent in his ivory tower. Now he was going to play the puppet master, fanning the flames of racial violence to shape events.

Arjuna had refused to fight, at the beginning of the *Gita*. Krishna's words seemed meant as much for Martell as for that ancient prince. "If, knowing thy duty and task, thou bidd'st / Duty and task go by—that shall be sin!" The words echoed through Martell's mind, as he tried to find solace in them.

"One at a time, damn it!" Siemens's voice cut through the clamor in the campaign headquarters. "Ann, what the hell is going on?"

"A riot in Houston, Rick. A mob attacked the Guard, the fighting got bloody. Couple dozen killed, lots more wounded."

"The Guard overreacted?"

"Overreacted, hell. The media's calling it a massacre."

"Hey, there's Andrews!" An aide pointed at a TV screens.

Johnson reached for the monitor. " . . . Let Siemens set the terms of this contest, but no longer. The party leadership pressed me not to bring up Siemens's fascist record, but my conscience must speak. This bloody massacre exposes the racist, tyrannical reality behind the glowing words. His goose-stepping militia is the antithesis—"

Siemens slapped the controls, and the sound cut off. "Goddamn Andrews! You can't trust liberals to stay bought. Get General Sinclair on the line, and then the Philadelphia Guard command. You, get a flight to Houston for Ann and me, and have Ramirez meet us at the airport. And someone call Martell."

Johnson grabbed his arm. "Make that one ticket. I'm out."

"You said you'd stay through the primary!"

"That was before your gunslingers mowed down a crowd! I'm not going to help whitewash this atrocity."

"Don't judge me by the actions of soldiers I never even met! Judge me by what I do to make sure it never happens again. I'll deal with the Guard, but I need to talk to the community, too. I need your help for that."

Johnson glared for a moment, then nodded. "OK, I'll come with you. But my promises are off. I'll set up a forum for you, I'll listen, and I'll decide."

Johnson bit the end off a cigar and spit it into the gutter. They were standing next to their rental car, in the parking lot of Redeemer Baptist Church. "I don't get it, Rick; why set this up and not bring the media in?"

"This is no time for sound-bites and smiles, Ann. We have a bomb to defuse." He waved with the Guard cap he'd borrowed, incongruous against his gray suit. "If I screw it up, there won't *be* any more campaign."

"You got me there." Johnson chewed on the cigar, but made no move to light it. "In a campaign, *everything* is PR, but this is over the edge." She pointed at the lone cameraman, unloading gear from a beat-up van. "At least there's the guy from the Reverend's TV station. You can

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get footage from him, if it's any good—and if there's still a campaign."

She looked at her watch and scowled. "Where the hell are your Guardsmen? Let's go on in, they can find us."

"You plan on smoking that stogie?"

Johnson took the cigar from her mouth, looked at it with vague surprise. "Didn't know I had it out." She stuck it in her coat pocket, and they headed in.

"Reverend Davis, it *is* good to meet you." Siemens shook hands, pressing his left hand briefly to Davis's shoulder. The elderly black cleric seemed frail, but his eyes blazed.

"General, I wish I hadn't supported bringing the Guard here." Davis shook his head sadly. "A tragic mistake, I fear."

"There is tragedy enough, here, Reverend, and plenty of mistakes, but I still believe we're on the same side."

"But is it the side of righteousness, General? *That* is the question we must always ask."

Siemens looked around the meeting hall, a sprawling room filled with moveable pews and folding chairs. He'd been to plenty of campaign dinners in rooms like this. This one was full, and the faces nearly all black. Ann and Reverend Davis had twisted arms and called in favors, and brought representatives from every black organization in the city.

They did not look happy.

The Guardsmen arrived, and found seats near the podium: three locals and three newcomers from Philadelphia. That had been Johnson's idea. If Siemens was by himself, he'd be seen as a politician, even without the media circus. These six showed that he was talking for the Guard.

Davis stepped to the lectern. "Brothers and sisters," he said, "this is a sorrowful time, and sorrow leads easily to anger. Anger can bring more pain, though, and greater tragedy. Before we go too far down that perilous road, we should stop and think, listen to the voices our anger opposes. Listen now to General Richard Siemens. I don't ask you to agree with him or even to believe him; I don't even know what he'll say. I do ask you to listen to him, with an open mind and an open heart."

Angry muttering swept the hall, against a few lonely "Amens." A young man stood in the back. "Came to talk *about* these honkies, not to listen *to* them."

"Hosea," answered Davis, "you came because this church pays for your offices *and* your newsletter. Now sit back down and listen. General, it's all yours."

Siemens took Davis's place, and put the cap before him on the lectern. He looked across the group: angry, tense faces. A long time since he'd been before a room as hostile as this. He picked up the cap, gestured with it.

"I wear no uniform or medals tonight, but I wore a Guard uniform for six years, and Air Force for two decades before then. It meant a lot to me. A symbol, of what I believed in, what I worked for, why I risked my life. I was proud of it. Now . . . now, for the first time, I'm ashamed."

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He looked around again. Had their attention, this wasn't what they were expecting.

"Let's talk about kids, two groups of kids. Damn-fool, reckless punks, about like I was—maybe some of you, too. Kids who wanted to be a part of something important. Who wanted to shape their lives, to stand up on their own. Kids who let their hearts lead them in the way of danger.

"Maybe none of them wanted a fight. I don't know, maybe some of them were hoping for a scrape, kids are like that. They started out that night with ideals, high purposes, but they were ready for a fight when it came. Both sides, thrashing like sharks at the smell of blood.

"Only *my* kids had *guns*. They *shot* your kids. *Killed* them.

"That's *murder*. And the kids who did it will be charged and prosecuted. Then it's up to judge and jury, but I pray for a conviction. Because I *damned* sure don't want this to happen again." His voice rose steadily. "I want every goddamn kid in the Guard waking up in the middle of the night in a cold sweat, scared to death that he might screw up so bad. And I want him a hell of a lot more scared of *me* than of any judge and jury."

Siemens paused a moment, then resumed in a soft voice. They were listening, against their will. He could feel their thoughts, tune his pace and tone to their response. "The hell of it is, it wasn't their fault. They were scared, they were confused. But they *should* have been *trained* for crap like that. They shouldn't have *had* live ammo, just tear gas and rubber bullets. Let a battle-hardened sergeant hold ammo in case some asshole on the other side started shooting.

"All that's the commander's fault. I wish to God I could keel-haul Ramirez, hanging's too good for him. Problem is, *he* didn't break any laws. I can court-martial him, but I can't do much but toss him out of the Guard. Even the racist crap that provoked this was his fault."

Siemens shook his head sadly. "His fault, and mine. I appointed him, I backed him, I saw the danger signs and I didn't act in time." He picked up the cap, turned it around to look at it like Hamlet staring at Yorick's skull. "I still believe." He looked back at the audience. "I believe that young men and women *can* break out of the ghetto, *can* find meaning and hope, *can* learn skills and trades. I believe in the power of the same forces the gangs have used so destructively—the burning desire for belonging and identity, the need to *be* somebody and *do* something.

"Harness those drives, and add training and discipline, a sense of duty and patriotism. The military has learned how to do that; let's put it to use. We *can* turn things around. God knows we need to. Damn it to hell, a country should judge itself not by how many millionaires it creates, but by how it treats its poorest and most vulnerable. . . .

"Hell, I'm off the point and onto politics. I'll stop talking and sit down, listen to you. But I accept responsibility for all this. I'm getting into politics to fight the racism and violence that created this tragedy. I can't go on with

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blood on my hands. If I can't convince you that I mean this, that I will work my butt off to heal this country, I'm out. Think it over. If you believe that I'm the problem instead of part of the solution, say so and I'll pull out of the senate race."

Siemens nodded at the audience, nodded at Rev. Davis, then walked back to his seat. Johnson was staring at the floor, probably wondering why he'd done all this if he was ready to pull out. It wouldn't come to that. *"If you believe"*—that was loose enough to drive a tank through.

Johnson looked up, and her expression was not anger. Not her professional good-old-girl smile, either. She looked like the Harvard Divinity graduate she was, eyes troubled, face pinched in concentration on a knotty issue of ethics.

Davis was back at the lectern, but Siemens didn't listen. He looked over the crowd, measuring their reaction. Frowns showed indecision. There was still hatred, particularly in the youngsters; they didn't like to be called kids, didn't want their anger and yearning labeled and filed. The older generation took him seriously. Several women nodded back at him, faces guarded. That was progress, from the attitudes a half hour ago.

The Guardsmen were restless. They wouldn't like his sermon either. One Chicano local was arguing with the Philly veterans. He shoved away a restraining arm, twisted, pushed to his feet. That bulge at his shoulder, glimpse of dark leather—Damn! Why the hell was he armed?

Siemens felt his blood surge. He slid forward on the seat, weight on the balls of his feet, ready to jump. Caesars, kings—how many leaders had been killed by their own guards?

He caught the eye of a sergeant from Philadelphia, and nodded for him to follow the kid. Gesture with the palm of the hand: slow and easy, don't rush the boy.

Siemens braced to dive for the floor. Undignified, but it would save his life. The kid wouldn't have a clear shot, and the sergeant wouldn't give time for more than one.

There! The Chicano was turning, reaching for his holster.

Half out of the chair, his legs tensed to jump, Siemens realized his mistake.

The kid was looking the wrong way. He wasn't aiming at Siemens, but at Davis.

Siemens lurched, jumped forward instead of down. He hit Davis like a linebacker blindsiding a quarterback. A sharp crack: the report of a gun. Siemens twisted as he carried Davis to the floor; didn't want to break Davis's neck.

A searing agony pierced his shoulder. Damn, had he hit the floor that hard? Only when he saw the hole in his jacket, and the spreading stain, did he realize he'd been hit.

Davis shook free, rolled over and looked up. "What in Heaven's name. . . ?" He stopped, squinted at Siemens's shoulder. "You're hurt! What happened?"

A Guardsman pushed through the crowd around them. "Sergeant Novac got him, sir." He stopped, shocked. "You're hit!"

"Oh, hell, it's nothing," said Siemens. "Through the muscle,

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maybe creased a rib—it's hardly bleeding. What possessed that bastard?"

"He was snarling about the, uh, blacks tearing down the Guard. He was hot as a griddle after you talked, and then when the Reverend spoke about forgiveness and tolerance he snapped, said the blacks had no place talking forgiveness when it was their fault."

Siemens nodded. "Reverend, this was a crime, not a Guard matter and not politics. I want to go on as if this hadn't happened."

"Hardly, General," said Davis. "You took a bullet meant for me. We can't forget that."

Johnson insisted that Siemens stay in the hospital for a week, until the day after the primary. She said the photos of Rev. Davis next to his hospital bed were worth a hundred thousand votes. The victory margin was a lot more than that, but they'd need all the momentum they could get for the general election.

Siemens didn't have any trouble reading her expression, now. He'd seen it often enough before, on the faces of soldiers who'd given their heart and soul to a Cause. *Lee to the rear,* Pickett's men had shouted, more afraid for their leader than themselves; *General Lee to the rear.*

"The incumbent sneers at our proposals, and says you can't solve problems by throwing money at them." Siemens grinned at the crowd—they were hanging on his words. "You know, he's right. These crises require new ideas, hard work, and strong leadership. But it *will* take a little money along the way. And let me tell you something, Senator Pryor—you sure as hell can't solve problems by throwing empty words at them, and that's all you've *ever* done."

"General, any comment on the annexation of Saudi Arabia?"

"Not that's printable." Siemens scowled. Ann and Martell were always badgering him about sticking to the script, but there were limits. "Screw that; put this as deep background, so deep it chaps my hemorrhoids. I didn't cry when Saigon fell, I'd wept long before for all the young men and women chewed up by that fiasco. I cried tears of rage at the news this morning.

"I know, the Islamic Federation is more than Iraq, and the Caliph isn't Saddam Hussein, but we *won* that war, and then we gave it away. If we'd finished him off, not left so much hardware for the Caliph to inherit—hell, if we'd kept any presence in the area, this wouldn't have happened. . . ."

"Jesus, Stan, are your folks running polls all the time?"

"That's voter ID." Martell looked past Siemens's shoulder, down into the Ops Room, then turned to sit at the conference table. "We want the name of every voter in the state who's for you so our E-day crew can make sure the bastards vote. For the undecided, they try to get enough info to pick a version of the roll-your-own TV ad." *Krishna knows, we need every edge.*

"You *do* have a new poll, don't

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you?" asked Ann Johnson.

"It's looking damn close." Martell handed an ash tray to Johnson; she didn't seem too concerned about her cigar. "We're swinging the undecided, but not making much dent in Pryor's support. The Monday night ad and the E-day drill should add a few points, but it may not be enough. Pryor can count on a big graveyard vote from East Texas."

"So what do we do?" asked Siemens.

"We do the best we can." Martell shrugged, and a sharp pain pierced his stomach. Ulcers? "We've got friends in South Texas who'll play the same game."

"What about intelligence?"

"Our polls, and Medea's analysis, are the best there are."

"Hell, Stan, I'm not talking about that. Have you got anyone in their camp? Phone taps, that sort of thing?"

Martell scowled. "That went out with Watergate."

"We're playing this for keeps," Siemens said. Ann Johnson looked like she wanted to spit, but she kept quiet. "If the other side is playing dirty, we better keep on top of what's happening. I've got friends in the business, you two won't have to be involved. . . . "

Siemens hesitated in the door of the Dog & Duck, annoyed to find several reporters there. He'd hoped they would have stuck to the hotel, or at least stayed around Sixth Street. He was in dire need of a drink after the latest grim briefing from Johnson. The D & D had a fine selection of single malt whiskey, as well as the best lineup of British ales and stouts in Austin.

The ABC reporter walked up as he ordered a Laguvalin. "I hear you've picked your staff advisors, General: Goebbels and Goering."

Siemens grimaced wearily. "That's not very funny, Carlson. Not original, either. It's a rip-off of the old line about Governor Moonbeam picking Jean Dixon and the Amazing Kreskin for his White House advisors."

"Touchy, aren't we?" Carlson smirked. "You don't have any sense of humor about yourself."

"Maybe I've just got higher standards than that." One slip, one unguarded comment, and look what it got you. Hell, the whole bar was listening. "The problem is that Nazis aren't funny. It works as an insult, but not as a joke."

"Oh, and I'm *sure* you could do much better."

"Probably." Can't back off now, have to ram it down his throat. Siemens swirled the dark whiskey in his glass, savored the sharp smell against the background of pipe smoke. "OK, Richard Siemens has picked his staff advisors: Mussolini and Lyndon LaRouche." That brought a chuckle from the listeners.

Carlson shook his head. "That's the same joke."

"They let you cover the news?" No point in politeness now. If Siemens won this duel, the other jackals of the press would love him, no matter how much blood spattered the elegant paneled walls. "The difference is, my version's funny. Mussolini couldn't beat Ethiopia, and nobody takes

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LaRouche seriously."

"It's still the same joke." Carlson was simmering, his face red. "You talk about new ideas, let's see you deliver."

"Hell, have I talked myself into a Cyrano?" Chairs scraped as people turned to listen. Good; enough of the reporters grinned at the reference for the play to work. "Let's start with the same form, but get away from ancient history. Siemens has chosen his advisers: Gordon Liddy and Dr. Strangelove. Or a military twist: General Insanity and Corporal Punishment."

Siemens sipped at the rich, peaty Scotch, then went on. "Since you folks make a big deal of my ego, we could play on that. 'What? You think I'm not smart enough on my own?' Or a cinematic allusion: 'Advisors? We don't need no stinking advisors!' Political: 'I decided to skip the advisors and double-team the spin-doctors.' Modest: 'You think I *paid* somebody for these crazy ideas?'"

He looked around the room, stirring his subconscious for ideas. There was always a way to win a crowd. Hell, he was brighter than these goons, and they were head and shoulders above their audiences. "Then there's the religious: 'I won't say who the advisors are, but their words come on stone tablets.' Turn that around, with the ego slant: 'I can't go to God for advice: He asks *me*.' And the academic. . . ."

The conference is in the War Room, but it isn't the War Room. The glass wall behind Martell looks out not on Ops, but on the marina and the Texas Hill Country beyond.

Around the conference table, faceless figures go through the motions of a silent argument. Mechanical gestures, mannequin heads turning with the ebb and flow of unheard discussion. Unheard by Martell, that is. All he can hear is the ticking of a clock.

Time is running out. And Martell is stuck in a meeting.

He can't hear, he can't speak. He can only nod and turn his head as the other automatons do. He has no idea what they are talking about, or why they think it matters. So what else is new? The featureless heads turn, the clock ticks on.

Silence.

The clock has run out.

The flash is behind him. North? Austin? Martell can't move, can't hide, but at least he doesn't turn towards it. The mannequins turn, heads snapping about. Even facing away, the hellish glare nearly blinds Martell. Still, he can see the smooth plastic faces twist and melt, running in rivulets down the scorched, smoking Brooks Brothers suits. There aren't even skulls behind the blank masks. The heads are empty shells, and when the fronts are gone, the backs wither and melt in the ever-brighter glare.

Martell finds his voice.

And screamed.

He felt the tender arms around him, comforting him, before he was fully awake. "It's OK, Stan, it's OK, only a dream." He hugged her fiercely, then buried his face in her hair as he ran his fingers across the satiny skin of

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her back.

"Why do you put up with me, Helen? Why do you keep coming back?"

"Silly!" She nuzzled his cheek, nipped an ear, then pulled back to look at him. "I guess I still love you." She smiled sadly and rapped him on the forehead. "Some of you, anyway. There're so many of you in there."

Martell sighed. "I must seem like a self-centered three-year-old, sometimes."

"I kind of like him. Brings out the maternal, maybe. He's more fun than the teenager who takes himself so seriously, or the old man, weary of the world."

"Sweet Helen, make me immoral with a kiss." Martell pulled her to him, but his eyes caught the clock by his bed. "Jesus, it's after 2 A.M.!"

"Don't worry, Stan, I told Tony I'd probably spend the night with you."

"You did *what?*" His heart pounded, the floor seemed to shift.

"I could tell you needed me, even if I didn't know how badly." She shook her head. "Don't tell me you thought he didn't know?"

Martell stared at her, speechless. He'd thought that he knew her, and Tony. The wave of guilt at betraying Tony fell away, replaced by confusion and fear. Had this been a casual roll in the hay, so unthreatening to their relationship? Worse, perhaps, an act of sympathy?

"Don't get your hopes up," she said, misreading his expression. "Tony trusts me, we love each other. It's just. . . ."

Dread built up within Martell. What could upset her so much that their tangled relationship was a side issue?

"I love you, too, Stan," she went on. "I couldn't live with you, but I love you, and I hate to see you wearing yourself so thin. But even more, I'm terribly afraid you've sold your soul to the devil. Anyone who thinks he can *use* Rick Siemens—" She buried her head against his shoulder, and began to cry.

Martell floated in the abstract decision space. No matter how he turned the image, there were no answers. None of the shock events he injected jarred the current worldline out of this chuté. A few fractal patches leaked off to sudden swings in either direction, but most of the paths ended in a dead heat.

The limits of this Vishnu-cursed technique were frustrating, but at least he didn't have the temptation of a last-minute kludge like that riot before the primary. Hundreds of hours analyzing effects, thousands of dollars setting the spark. Should have cut Siemens's margin in the primary, but strengthened him for the general election, avoided this horse race.

Instead, the bastard pulled a heroic stunt, won the primary in a landslide, but diverted the worldline from the chute Martell was aiming for. In sociodynamics as in orbital mechanics, a direct shove toward your goal could be a bad move.

Now they might lose the race, and the big picture was worse than ever. The Islamic Federation was consolidating power in the Middle East, Turkey looked like a powder keg. Martell had hoped for five or six years

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to set up his plan. He'd be lucky to get three. There wouldn't be time for a second try.

Siemens *had* to win; they *had* to have him ready in the Senate, for the larger plan. Sociodynamics had gotten them this far, turning a long shot campaign into a dead heat. Now it all depended on the tailored ad and the election day drill.

And it was time to call in the under-the-table offers, raise some illegal funds for illegal uses. Siemens's surveillance ideas could be crucial, too. Compunctions were ludicrous, Martell told himself. He had blood on his hands already—going to jail was the least of his worries.

Siemens groaned as he slipped into the limo. "If I ever see another rubber chicken banquet, I'm going to puke all over it."

"Brace yourself," Johnson said from the facing seat. "You've got another lunch in thirty minutes."

"Oh, hell. I thought we were heading to the Lockheed plant?" Christ, this *was* getting as hectic as a war.

"That's not till 3 o'clock. Downtown Rotary next, but I can call and say you want a salad."

"God, yes." When this campaign was over, he was going to celebrate with a Thai feast. Or Indian, maybe, something with some flavor. "Martell have any new projections?"

"Yeah." Johnson snorted. "He says it's going to be a tie."

"Great." Siemens twisted in his seat to stretch his sore back. Two more days. "Ann, do you think Pryor will try any last minute mud-slinging?"

"It's too late for that. Voters discount accusations when you don't have time to respond. This close to the election, anything short of photos of you screwing a goat would backfire." Johnson grinned. "So don't screw any goats for the next couple of days—at least, not with photographers around."

The ads ran as a roadblock. Luke Wilson booked identical time slots on four networks and six cable channels, statewide. Individually tailored, for two million households; segmented by narrow demographics, for millions more.

The ninety-second slot was divided into five segments. When the time arrived, eight versions *of each segment* were transmitted at the same time. Every version was sculpted so that transitions were smooth; more than 16,000 seamless combinations.

The new cable controllers, in millions of households across the state, had enough programmable capacity that individual schedules could be downloaded ahead of time. If the residents had their TV on at air-time, the controller would switch between segments to create a combined version individually tailored to their prejudices and interests. Medea had collected enough survey data to pick specific versions for each of two million families; census data provided good guesses for the others. For broadcast viewers, the natural demographics of each channel allowed broad-brush matching.

George Orwell would have rolled over in his grave.

* * *

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The War Room, election day.

Martell watched the map on the wall-screen fill in with blue as votes-cast tallies came in from poll-watchers around the state. Across the table, Siemens looked bored.

Below, the Ops Room was at full shift. These E-day calls required little human intervention. Over 4,000 calls were in progress, half a million completions an hour.

"Medea, start the weighting."

Enlarged graphics of the major cities appeared, and more colors washed across the map. Medea was comparing the 11 A.M. tally to historical timelines for each precinct, projecting an end-of-day turnout for the box. Multiplying by the "percent favorable" forecast from surveys gave a total vote, precinct by precinct. Few voters changed their minds on election day; the variable was turnout.

Adding up the projections gave a revised, hour by hour reforecast of the election. More important was to find the precincts with high potential for Siemens that were delivering low turnout, and then get the SOBs to the polls.

"Damn, the Montrose district is *still* showing under 60 percent of what we counted on. Medea, call the Houston office." Martell spat out orders to get sound cars and minibuses into the area, then waved at the camera to hang up. "Make sure the calls there ask if people need a ride to the poll."

"Acknowledged," answered Medea.

Siemens stood and stretched. "All this fuss, over sound cars and busses? Can they make that much difference?"

"Not hardly. No, this is a sop, to make me feel useful. Medea and those operators below are doing the real work, over five million calls today. I only manage resources she doesn't control, where soft demographics and instinct matter." And we could have given her the rules for that, too.

"Hell, what's five million phone calls? There are 30 million people in this state."

"But how many vote? Besides, we're only calling those who've already said they'd vote for you. We target in on critical precincts like an artillery barrage. The way the numbers pop up at the next checkpoint, I can see people running out their doors in unison. Some of those poor bastards, we'll call eight or ten times by the end of the day." Martell shook his head. "You'd think they'd figure out that we'd quit calling, if they'd lie and say they'd already voted."

Siemens clapped him on the shoulder. "I wish we'd had you running logistics in the Gulf. I'd better get going—cheering on the troops at the campaign offices in Austin and Dallas. See you at the safe house tonight?"

"Rick, I still don't like that."

"It's *done,* Stan. If Pryor is stuffing ballot boxes, I want to know the score. My boys have the surveillance set up; you line up your connections in the Valley, in case we have to do some stuffing of our own."

Martell waved resignedly as Siemens went out the door, then turned back to the display. The colors were stable now, the weighting finished. Statewide polls had Siemens losing by seven percent only yesterday; the ad last night had cut that to

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three percent. These projections confirmed that the E-day drill would make it damn close. Vote fraud might be the margin, either way.

Anyone who thought he could use *Rick Siemens . . .* she'd said. Was what? A hopeless fool? Crazy?

Or just rock-bottom, stone-the-crows desperate?

Hell. "Medea, fire a ten minute phone salvo at Pryor's HQ. Every time they hang up, call again. Finish with thirty seconds of every line you've got—see if you can snarl their exchange."

Ride the tiger, ride the tiger.

"That's it, Pryor's bought his last vote." Siemens pulled off the headphones and stretched. A long night, like launching an air strike and waiting at HQ for word to trickle back. He waved at the signals officer at the dining table to keep monitoring. "OK, where do we stand?"

"Just a minute." Martell was hunched over his laptop, with an encrypted link to Medea. "He's underestimating our margin in West Texas. He bought the 'premature' report from the Valley, too, he doesn't know we're holding back some boxes." His hands danced across the keys—how did he keep up that obsolete skill? "By God, I think we've done it. His fraud won't be enough, we'll win anyway."

"By how much?"

"I'd say 70 percent confidence of victory, but damn all little margin." Martell scowled. "I know, that's not good enough. I hate to say it, but we'd better go with the countermeasures."

"I figured that all along." Siemens strolled to the buffet, trailing his hand along the chintz sofa. He opened the briefcase on the buffet, idly thumbed a few stacks of $100 bills. "Illegal campaign donations, perfect for bribes—the money never goes on the books."

"I *hoped* we wouldn't need this. OK, send it south. Tell Parker 15,000 votes net; much more from that little town would be ludicrous."

"I'll send a bagman in an Osprey." The Rio Grande Valley politico wanted cash on the barrel—or, rather, on the ballot box.

"You're sending a Guard Osprey? That's discreet?"

"It's *fast*. Discreet enough, landing fifteen miles from town. We've got Ospreys flying all over tonight, for 'training.'"

Siemens picked up the briefcase and strode to the kitchen, gave instructions to a lieutenant waiting there. Pacing back, he laced his fingers above his head, cracked his knuckles. "Fifteen thousand votes doesn't sound like much."

"It's peanuts, a fraction of a percent. I'm sure my projections are accurate to smaller numbers than that, though. Asking for more would be dangerous. You'd have nearly an 8,000 vote margin from Parker's boxes, anyway. He can double that by throwing away a few thousand Republican votes, and having his people spend the night forging ballots. I hope he doesn't put the names down alphabetically, like that fool in '48."

"No shit." The roar of the Osprey reverberated through the farmhouse. It stirred Siemens's blood; even in combat, the thrill of flight stayed with

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him. "Look past the election: what do your forecasts say now?"

"Domestic, or international?"

"Any fool can see this county's headed for hell in a handbasket. What's the world scene?"

"It's going to be Turkey." Martell propped his elbows on the coffee table, rested his head against his hands. "We thought for a while that Southeast Asia was the key, with Japan rearming, but your other war is coming back to haunt you."

"Sure," said Siemens. "It griped me to see the Caliph roll over the Saudis, but *Turkey?*"

"That's where it all comes together. The Caliph wants Turkey; Iran and Iraq both have old scores to settle there. Russia has a chip on its shoulder from losing the old Soviet empire, and the generals covet the Dardenelles." Martell sighed loudly, and shook his head. "They're going to have a special grudge against the Islamic Federation, soon. We project 85 percent confidence that Kazakhstan will join the IF within three weeks."

"Kazakhstan!" Siemens blood felt as if it was curdling in his veins. "They've still got SS-10s, with megaton MIRVs. Hell, they could hit the US with those buggers."

"Sir!" The signals officer was waving. "General Siemens, you better listen to this."

Siemens leaped around the sofa, slapping a headphone to his ear. The gravely voice sounded like Pete deSilva, Pryor's campaign manager. *". . . All night, damn it. We gave you the numbers; fill in the ballots and count 'em up."*

"But, Pete, a lot of boxes are still out. Specially out west, where Siemens is pulling heavy margins."

"It's damn late to be improvising, Williams. I'll talk to the Senator. Give me your number, I'll call right back."

Siemens waved urgently at Martell, who nodded, his hands again on the keyboard. It was a stroke of luck, getting the phone number; they could cross-check the location in moments.

DeSilva hung up after that, and Siemens handed the headset to the Guardsman. He could feel the victory slipping away, votes leaking out like blood from a shrapnel wound. He turned to Martell. "We've got a problem, Stan."

"No shit. There's no margin to spare." Martell had stopped keying, but his fingernails tapped an impatient tattoo on the table as he stared at the little screen. "Damn! He was calling from a church in Lake Jackson, 150 miles from here. Williams—that'd be Dave Williams, a county commissioner."

"The other Osprey's still out back; get your butt over there."

"Huh?" Martell jerked back in his chair. "We need an election judge, somebody with authority. They wouldn't know me from Adam."

"The problem is they *would* know *me*—wouldn't let me in the door. Nobody else here could talk politics convincingly, and fetching someone from Austin or Dallas will take an hour we can't spare. I'll have a taxi meet you at the county airport."

"Hell, you're the hero, I'm just a thinker."

"You're too goddamned hard on

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yourself. Sure, you fight with ideas and numbers, you sit back and pull strings; that doesn't mean you *can't* act on your own. This time, you *have* to."

"How? What do I do?"

"Get the hell over there: lie, bluff, threaten, anything to slow them down, buy us some time. *Do it*; I'll back you up quick as I can." And if you can't get over your stage fright about finally having to do something, thought Siemens, you're never going to survive the real challenges *after* the election. "Take the SAR beacon from the Osprey, trigger it when you find the church. If I can dig up an election judge at this hour, I'll fly him in."

Martell shoved the old ID card in Dave Williams's face. "This *is* identification. You expect an election judge to carry testimonials?" He'd been too cold and miserable to bluster well at first, but he was plenty mad now. "You've wasted enough of my time; let me in to do my job."

"Big deal." Williams batted his hand aside. "A picture ID, says 'State of Texas.' I got a driver's license more official than that. I thought you were maybe a reporter, but looks like you're just a pest. Get out of here, or I'll call the cops."

"You *do* that, Mr. Williams." This arrogant SOB had the local law solidly in his pocket, but Martell was past worrying about jail. "The police will verify my credentials quickly, as *you* could have thirty minutes ago if you'd let me use your phone."

Frustration and anger battled fatigue in his veins, and the icy wind clawed at his lightweight jacket. At least Martell could hope that Williams had stopped the forging until the intruder was dealt with. Williams was acting cocky, now. He'd be back stuffing the ballot box before long, even if Martell stayed out here on the church steps freezing his butt. Maybe it would be worthwhile slugging this bastard; the commotion might buy a little more delay. Where the hell was Siemens's cavalry?

"You want to make a call, there's a pay phone down the road," Williams said. "Better yet, keep on driving. That *might* keep you out of the hoosegow." A distant rumble followed his words. Thunder? No, the sky was clear, sparkling with stars.

"Mr. Williams, you're making a serious mistake." The rumble got louder; Williams glanced around, scowling.

"The only mistake *I'm* making is wasting my time with you. I'm sure one of the boys has got a deer rifle in his truck—you better move along before we get aggravated."

"You really should deal with *me*." Yes! A cluster of red lights moved against the stars. Siemens must have dug up a real election judge, sent the Osprey after him. "Higher authorities may take offense at your chasing me off."

"Get moving! Or you'll be dealing with 'higher authorities'—What the hell is *that?*"

The sound swelled, receded for a moment, then rose to a throaty roar. A shrill turbine whine overlay the deep growl of the blades. The shifting constellation of lights confused Martell; it was huge, much too big for an Osprey.

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A powerful searchlight snapped on, groped around the parking lot. The beam licked at the cars, danced, followed the sidewalk to pin them in its brilliance. The sound grew to bone rattling intensity. Another beam stabbed down, and the image suddenly made sense. It wasn't one large aircraft up there, it was four or five Ospreys; hell, maybe eight or ten.

The lead ship descended toward the parking lot. Another Osprey kept close behind, above and to the side in a covering position. Both turned on service lights as well, highlighting their evil, insectoid shape, as well as the miniguns and rockets prominently aimed at the church.

"Jesus H. Christ," cried Williams, his shrill voice hardly audible above the tumult. Martell wanted to duck under the hedge himself, and these guys were on his side. The Ospreys were troop carriers, not gunships, but their weapons could shred the wood-frame church into kindling. Emotions churned in his stomach, knotting with pain. This was the rescue he'd hoped for . . . and these were the ruthless warriors he was setting loose on the world.

The nearest Osprey landed and its props began to slow. The hatch opened and a figure stepped out. Hard to see against the glare of the spotlights still aimed at the church. Someone in a bathrobe? No, that was Siemens's smoking jacket! But the mane of white hair —

Martell turned to Williams, forcing his expression to glee. "Looks like my boss. Have you met the Secretary of State?"

Williams was still struggling for words when Secretary Pauli reached the steps. "Dave Williams, as I live and breathe! I haven't seen you in a hound's age. Hello, Stan. Dave, I sure hate to bother you, I know you'd like nothing better than to get this over with and go home to bed. There've been some nasty things said, though. This is a close election, and we can't let even the hint of impropriety taint the results." He had his arm on Williams's shoulder, herding him to the door of the church. "I *know* there's nothing to these allegations, and I don't want your reputation or Pryor's sullied by such nonsense, so I felt I had to come down here myself, and serve as a witness. I'll be right there with you, and I can look the world in the eye and damn such lies for the calumnies they are. Let's get in there and count those ballots, shall we?"

Williams cast a murderous look over his shoulder at Martell, then opened the door.

Thirty-seven votes. Shiva's blood! The narrow margin still made Martell shudder.

Three weeks had passed, and for the first time since the election—no, the first time since March—Martell had time to relax. He sank into the plush leather chair in his study and sipped at his Scotch.

There had been a recount, of course. Medea helped pick precincts for special attention, and the margin rose to a few hundred. Out of 8 million votes.

Krishna! Williams's aborted fraud

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would have tilted it the other way. Hell, he could have forged several hundred more ballots before Pauli got there, if Martell hadn't kept him tied up on the church steps.

Out of the whole campaign, the image that stayed with Martell was of that little church. Pauli, lounging back in a folding chair, eyes half closed but missing nothing, blue pin-stripe trousers under the smoking jacket; he explained later that Siemens had suggested it for the image of an irate official dragged out of bed. Two Guardsmen standing ramrod stiff by the door, eyes ahead, ostentatiously ignoring everyone, but impossible to ignore. Dave Williams, staring at a ballot, studiously marking a tally, drawing on his cigarette, glaring at Pauli, glaring at Martell, standing up, walking around the table, sitting down and picking up another ballot. All night long.

What was it that he'd said to Williams, while they were arguing about ID? Something about not having testimonials. Well, he didn't need testimonials, and he didn't need a Wizard to tell him he had a heart. He could no longer pretend to himself and to the world that he was an icy automaton.

Yes, he'd felt passion: rage at Williams; fear at the whole plan slipping away . . . and guilt, at the blood he'd caused to be shed "for the greater good." It wasn't right to bury that passion. This wild scheme, this grand Plan could too easily slide into inhuman madness if he tried to wall away his feelings.

On the glass table, next to his Scotch, lay his clarinet. He'd played it this evening for the first time in years. It wasn't lack of genius that had driven him away from painting, sculpture, and music . . . it was lack of passion. He could never let go, he'd thought that he didn't have the passion, and he knew that he'd never get beyond mediocre without it.

Martell looked at the agni by the fireplace, but it held no solace. It was a reminder of the Hindu writings that he treasured, but in itself it meant nothing. His gaze rose to the ceiling, and the miniature video lens hidden there.

Medea, cast me a spell, show me the future, send me a True Dream. Have we won a great victory?

Or have I sown the dragon's teeth? ■

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Dreamfall, Joan Vinge, Warner, $22.95, 447 pp. (ISBN: 0-446-51627-9).
The Nature of Smoke, Anne Harris, TOR, $21.95, 285 pp. (ISBN: 0-312-85286-X).
Signs of Life, Cherry Wilder, TOR, $23.95, 349 pp. (ISBN: 0-312-86171-0).
The Ringworld Throne, Larry Niven, Ballantine/Del Rey, $23, 424 pp. (ISBN: 0-345-35861-9).
Dinotopia Lost, Alan Dean Foster, Turner Publishing (1050 Techwood Drive, NW, Atlanta, GA 30318, 404-885-4676), $21.95, 319 pp. (ISBN: 1-57036-279-3).
How to Save the World, Charles Sheffield, ed., TOR, $23.95, 349 pp. (ISBN: 0-312-85577-X).
Islands in the Sky: Bold New Ideas for Colonizing Space, Stanley Schmidt and Robert Zubrin, eds., Wiley, $14.95, 266 pp. (ISBN: 0-471-13561-5).

Some 14 years ago, Joan Vinge began her "Cat" series with *Psion*. This book introduced Cat, a hybrid of human and Hydran, humanoid aliens with green eyes and psi powers (and apparently close kin to humans, in that both were creations of a long-vanished super-race). Since Hydrans are *different*, both visibly and threateningly, they are persecuted. Since they cannot kill without suffering psionic feedback that kills them too, they are easy meat. Their worlds and possessions have been stolen, the few survivors live either on reservations or in ghettoes. And the hybrids are scum to both their parent peoples. In other words, Cat was a perfect hero for an anti-discrimination "bigot-bait makes good" story. He suffered too, for when he killed the villain, he lost his psi powers (hybrids are tougher than Hydrans). On the other hand, he gained education, skills, and allies that would serve him well in future adventures.

Dreamfall brings Cat to the original homeworld of the Hydrans. Now known as Refuge, it is the exclusive preserve of a corporate monster bent on exploiting the novelties to be found in the "reefs" that have accumulated as the local "cloud-whales" (also creations of that super-race) have shed their solidified thoughts in their droppings. The Hydrans occupy a reservation and are persecuted by bigots who call them freaks.

The bigots are bad enough to have drawn some perfunctory attention

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from the central human authority. Cat is part of a research team invited in by the corporation to help them look good. But shortly after his arrival, Cat runs head-on into a local resistance movement, is bullied by a sadistic security chief, and finds his life's true love. From here on, the general outline of the story is fairly predictable, but Vinge is good enough not to let that trap her. Yes, true love triumphs and the villains get it in the neck, yet the tale ends on a painful note that leaves Cat free for another sequel. Along the way, Vinge displays her potent imagination in the creation of a world that remains fascinating despite the damage done by exploiters. She also displays virtuoso quality in her delvings into the emotional torments of her characters, so that one emerges at the end feeling wrung-out and very satisfied.

Recommended. *Dreamfall* strikes me as a much stronger book than *Psion*. This has become a series to collect.

Anne Harris's first novel is a curious blend of quantum nonlocality, chaos theory, bioengineering, artificial intelligence, snuff films, broken families, and more. There's even a mad scientist.

Does it work? In a word, yes. I found **The Nature of Smoke** quite readable. I balked at some of the tidbits Harris asks her readers to swallow, but her momentum was enough to keep me going, and at the end I felt satisfied. What more can a reader ask?

A clue to the story? OK. She begins with the po' trash squatting in a Detroit slum. Magnolia is newly grown, well aware of the fate ahead of her, and when her moment comes, she cuts and runs, all the way to New York, where she is picked up by a slick dude with a penthouse, a camera, and a set of manacles. Magnolia's cool, though, very quick on her feet, very decisive, and possessed of very good instincts. She keeps everything but one wrist out of the manacles, and when the dude shows up with a knife, she takes it away from him. Cuts and runs again. Leaving one very sore enemy behind.

The camera was live. There were witnesses, including the mad scientist, who thinks Magnolia might just have the spark he needs. If he can just capture it in a personality template, he may finally be able to give his androids the independence, the true artificial intelligence, that he has achieved only once before in his career. He therefore gets in touch with Magnolia and invites her to come to Tunis.

The fly in the ointment is his earlier success, an aquatic humanoid named Tumcari who is far too independent to suit his creator. He diverts Magnolia to the lab in Siberia where Cid is studying the mitochondria in Tumcari's cells and discovering that they seem to be in communication with each other. That's the nonlocality.

Cid introduces Magnolia to the Mandelbrot set (chaos theory) and becomes her lover. She does not lay out Penrose's suppositions that consciousness depends on quantum chaos in the brain, but I'm pretty sure that had to be in Harris's mind, for

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Cid's next step is to design a virus to transfer Tumcari's mitochondria into other bodies, including her own and any androids around.

Complications ensue. The dude reenters the story. The mad scientist finds out where Magnolia is. Events turn violent. Personalities change. The dead rise again.

Harris has a jaunty touch with both characters and events. She believes in women who fight back with knives and boiling oil and more. She has a sense of humor, and it shows. She's inventive. And if this novel seems a little light, she holds the potential for great things. She makes me think of George Alec Effinger. I'm looking forward to her next.

In July 1982, I reviewed Cherry Wilder's *Second Nature,* set on the world of Rhomary, long ago settled by the survivors of a wrecked starship. The people of Wilder's vision were gentle, dedicated to the gathering of information, of knowledge, both for its own sake and because it was essential to survival.

Meet this world and such people again in **Signs of Life**. The starship *Serendip Dana* is in trouble. Its crew and passengers, including the paramilitary maintenance force known as the Silvos, share themselves out among the ship's T-shaped sections or Capems. The segments separate and head for a green and apparently empty world. One, Capem Fiver, lands on an island. The others . . . well, the few signals that come in suggest disaster. The world, of course, is Rhomary. The natives have seen the Capems come down, and they are moving toward their landing sites. But their technology is primitive by star-traveler standards—they use sailing vessels, of all things—and it will be awhile before they can hope to succor any survivors. Meanwhile, Capem Fiver's survivors are doing all right, setting up camp, finding water, staking a claim to a world they think is all theirs.

The worst offenders are the Silvos. They have more than a little of that old-time colonial grabbiness. They also carry illegal guns so they can go hunting whenever they get a chance, which means as soon as they spot something that looks edible.

The rest of the Fiver folk are almost as civilized as the Rhomaryans, pursuing knowledge, peace, willing to grant that this world may have inhabitants such as those a few have seen in very true-seeming dreams (Wilder likes a touch of psi talent), and having serious difficulties when the Silvos and a few power-hungry others seize control of the encampment. They are a different sort of people, says Wilder. They belong to a different "tribe," and then she goes on to suggest that her far-future civilization takes very explicit notice of such things: a tribe such as the Silvos has a charter that permits it to reorganize as certain other kinds of tribe. The language here may be a little different from what we are used to, but Wilder is making a very interesting point. If one approach does not work, try another—but most people have a limited choice of alternatives; they do not see and cannot accept some of the possibilities (sexuality offers some obvious ex-

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amples). Those whose vision is less limited must find it easier to adapt when life takes a drastic turn.

Wilder's characters are a bit cryptic, sometimes appearing to draw knowledge from the air, which may be why I often found it difficult to identify with them, but they are overall convincing enough. Her world is a minimalist stage set, for she is not given to lush description; perhaps that will put some readers off, but I found it a refreshing contrast to the overwriting that is so common. Her story works itself out logically and ends on a very satisfying note.

Why do I not sound more enthusiastic? Perhaps it is that "cryptic" and "minimalist" and "logical" add up to something too cool, too passionless for enthusiasm. But Wilder's work remains quite interesting, for which I do recommend it.

Larry Niven's "Tales of Known Space" future history is now over 30 years old. It has encompassed visions of two-headed Puppeteers, tigerish Kzinti, a humanity that has an adult form, the Pak protector, triggered by a special virus, and of course that capstone of cosmic engineering, the Ringworld. These visions established Niven as a star in the SF firmament, and his name would have remained memorable if he had never done anything else. Of course, he did, but that's a different story—or, rather, a whole 'nother shelf full of stories.

Ringworld, the novel, appeared in 1970 and promptly won a Hugo, a Nebula, and a Ditmar (Australia's prize for best international SF). *Ringworld Engineers* appeared in 1979. And now we have—a fanfare, please, maestro—**The Ringworld Throne.**

Is it worth that trumpet blast? If you recall the older novels fondly, you need hardly ask. If you're a newcomer to the field, you will probably find *Throne* confusing and cryptic (which often happens when one comes cold to a sequel). If your memory is a mite vague—it's been awhile, after all—you will need reminding, like so: Protectors are super-smart, super-strong, and dedicated to protecting their genetic kin. Obvious need can impel them to cooperate with each other, but lacking such urgency, they are prone to duels. In the past, such duels have destroyed worlds. The Ringworld, when found by Louis Wu and his companions, including an exiled Puppeteer named Hindmost, was in danger of wobbling into its sun. A meteorite impact had destabilized it, and the engines that would have corrected the problem had been removed by one of the Ringworld's many peoples to make starships. Wu solved the problem, but at the cost of a terrific load of guilt. Now he wanders about the place, meeting peoples, enjoying his status as a legend, growing old, rejecting the Hindmost's medical help, and preparing to die.

Meanwhile, other folks have problems. A squad of Machine People, traders with steam-driven vehicles, have come to an area where a population explosion of vampires threatens all. They join the battle, recruit local Ghouls (the Ringworld's cleanup crew), and go forth to exterminate the infestation. They succeed, but the

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point of their adventure is to show the Ghouls as a people of surprising abilities, including a Ringworld-wide communication system. At the same time, lurkers appear and shadow the adventurers. Something strange is going on.

The Hindmost has tools that permit observation of and links to distant places. He sees disturbing things, including outside ships attempting to land on the Ringworld and being repeatedly destroyed. He talks to Louis Wu and invites him to be rejuvenated. Eventually, Wu consents and steps through a transporter. And BOOM! a protector is on his back, attacking the Hindmost, taking them both hostage.

What is going on? The Ringworld is being defended. There are a number of Protectors in play, and a potential for explosively destructive action. Louis Wu and Hindmost must do the best they can to defuse the situation, even as the Protectors prepare to war against each other.

Who succeeds? All I will say is that it's an uphill struggle, and the reader should keep an eye on left field. Niven has surprises in store.

Unfortunately, though Niven is usually a subtle, tricksy fellow, he sometimes strikes me as concealing his hand a bit ostentatiously. This can be annoying, but not enough so to spoil the story.

James Gurney's *Dinotopia* seems to have become something of a phenomenon. A classic lost world, untouched by time ever since the dinosaurs ruled the Earth—and they're still there, still in their ancient bodies (complete with tiny brains) yet somehow evolved to intelligence of a very genteel, civilized sort. And humans are there too, for though Dinotopia is isolated by ocean currents that destroy every ship that ventures near, castaways of every race and station have been making it to shore for millennia. Now the culture is a joint affair, with dinos doing the heavy lifting and humans providing back rubs. Now? Well, no, not even in fiction in a world where airplanes and satellites have long made such "lost worlds" untenable. But in the nineteenth century, yes, and it's a marvelous concept. Everyone loves dinosaurs, even if they haven't been cuted up and civilized. How could Gurney lose?

Of course, he didn't. According to his publisher, *Dinotopia: A Land Apart from Time* has sold over a million copies in 19 languages since 1993. Its sequel, *Dinotopia: The World Beneath* (1995), is doing near as well. So what could be more natural in this age of commercialism than to franchise the gimmick?

The first Dinotopian sharecropper or subcontractor is Alan Dean Foster, whose **Dinotopia Lost** echoes in both title and cover illustration Hilton's classic of Shangri-La, *Lost Horizon*. The tale itself echoes a bit of *Treasure Island*. Unfortunately, all the echoes lack the richness of the original, and Foster's story adds far too little that is new.

Dinotopia Lost is a relatively simple story. As it opens, farmers are evacuating the coast, fleeing the ferocity of a monster "six-year" storm. At the same time, a pirate ship, crewed by ferocious desperadoes and captained

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by the dread Brognar Blackstrap himself, is riding the stormwinds and the currents toward the Dinotopian coast. A huge wave carries the ship over the reef, and it has arrived, uniquely intact and loaded with plunderers, rapists, and murderers who know no restraint.

Once on shore, the pirates encounter a struthiomimus family, think they're just overgrown, featherless chickens, decide they're exotic enough to be worth a bundle, and tie them up. They then march on, finding an entrance into the Rainy Basin where the savage carnosaurs (including *Tyrannosaurus rex*) dwell. One of their captives escapes and flees for help; she has a number of very close shaves, but she's got pluck (no feathers, you see), and she makes it. Just. And soon young Will Denison is on his way, accompanied by the struthiomimus and a protoceratopsian translator. Meanwhile, the pirates have managed to survive a few encounters themselves. They're impressed. But they're also looters. They add a baby tyrannosaurus to their captives, quite unaware that she's just a sprat and not at all appreciating what sort of parents will be looking for them. And then they stumble on an abandoned city built all of gold and silver bricks and adorned with jewels. They are downright delirious.

Meanwhile, young Will and his companions have met the baby tyrannosaurus's parents and managed to talk themselves out of being eaten on the spot. They are hot on the pirates' trail, with Will riding like a hat on the male rex's head. And the sky is still growing darker as the monster storm approaches.

As you can see, the romanticism is pretty intense. The mode of adventure is classic, and—partly because Foster has kept both story and prose fairly uncomplicated and partly because nobody gets hurt until the very end (and then only because they really have it coming)—just as appropriate for youngsters as it ever was. It should also appeal to anyone who refuses to permit being a grownup to get in the way of having fun.

Those of you who think lost worlds are just too, too quaint a notion for modern fiction, or who think that talking dinosaurs shouldn't sound like people in funny suits, or who think that realistic pirates would surely commit a little more actual mayhem—well, you can always pass it to the kids. *They'll* love it.

The premise for Charles Sheffield's anthology, **How to Save the World,** is quite simple: writers are observers of humanity, able to see the errors of human ways from the outside, to call attention to them, and even to point out necessary correctives. Science fiction writers "tend to be interested in global problems, in the impact of science and technology, and in the long-term future of humanity. They are observers of events at the largest scale." "In addition it is a widely-held opinion (at least among science fiction writers, if not the rest of the world) that SF writers are smarter than all other people. Unfortunately, or some would say fortunately, science fiction writers are seldom given a chance to prove that fact."

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Clearly, Sheffield's tongue is a bit in cheek, but that's a fine way to make a point, and it's a way not at all neglected by the contributors to this volume. Consider, for instance, the way—and to what effect—Brenda Clough blenderizes the races in "The Product of the Extremes," or how James Hogan allows you, if you are so inclined, to push a button and exterminate your chosen SOB, in "Zap Thy Neighbor." The book's thirteen stories also include items by Geoffrey Landis, Nick Pollotta, Doug Beason, and more; there's even a pair by Sheffield, one pseudonymous (I'm pretty sure) and one with Jerry Pournelle that will seem very familiar to *Analog* readers (a short version of *Higher Education,* serialized here February-May 1996). Does the book have any stories that take themselves seriously? "Higher Education" does, of course. In a more contemporary vein, there's Larry Niven's "The South Los Angeles Broadcasting System," which makes a very poignant point about how the definition of "newsworthy" affects the news, and hence the destinies of cities and people. And I should not fail to mention Lawrence Watt-Evans's "Choice," which suggests that if we could give people exactly what they want, we might solve the population problem; it isn't funny at all.

ANADEMS

Over the years, this magazine has published a great many science articles, many of them dealing with space travel. They have pointed out potential pathways to space and made numerous suggestions—solidly grounded in orbital mechanics, physics, and engineering—for new technologies, procedures, and devices. Some of these ideas have been doable now; many have called for materials and fuels that won't be available for decades (or more). All have needed a level of national commitment—in both money and spirit—that has been sadly lacking. So we dream on, some of us writing fiction, some of us theorizing and drafting and modeling and even building, working toward a day when dreams may become reality. If you wish to see what sort of dreams I mean, pick up a copy of **Islands in the Sky: Bold New Ideas for Colonizing Space,** edited by Stanley Schmidt and Robert Zubrin. It's an anthology of *Analog* articles on ways to get into space, move among the planets, and reach further yet, to the stars themselves. Here are Stine, Zubrin, Gillett, Forward, Fogg, Cramer, and more, on tachyon and negative matter space drives, skyhooks, magnetic sails, terraforming, colonizing Mars, and so on.

You say you've read this already, right here in the magazine? Of course you have, my dears, but in book format the diagrams and photos are clearer, the pages are bigger, and the heft in the hand is more satisfying. As a book, the presentation is more unified. With it, you won't have to hunt through that moldering pile of back issues. It takes up less space on a bookshelf. And it's the perfect gift for someone who shares the dream but can't tolerate the "sci-fi." If you want to spread the dream, give a copy to your local high school library.

Alas, there is no index. ■

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Dear Stan:

I just read the April *Analog* which I got on talking book record from the National Library Service for the blind and physically handicapped.

The story "Big John" reminds me of a number one song from the fall of 1961 called "Big Bad John." Could you please ask the author if his story was based on this song? If it was, I know what was written on the stone—"At the bottom of this mine, lies a big big man, Big John."

I remember you mentioned you would not print letters if they were not typed—my typing skills are not that good and I don't write very much. But I'd like to have my question answered.

Keep up the good work.

VICTOR SCHMIDT

734 Easley Street
Silver Spring, MD 20910

The author replies. . . .

You're right on with your music history. "Big John" is one of my favorite songs, and since you remember the year it was released, is there any chance you remember who sang it? I think it's Tennessee Ernie Ford, but I'm not sure.

What happened was, I was cruising down the highway listening to the song on the Country Oldies station before it tragically died from lack of listenership. And "Big John" came on, and I sang along with it like I always do, enjoying the chills down my spine at the end of the song like I always do. I reflected on the sad ending, and it occurred to me that maybe there was another possibility for the origins of such an enigmatic man—and maybe the possibility that he survived after all. And thus my story was born.

Here's a tip to reward you for writing a friendly letter: John Lewis, the name of the miner saved by John Andropolis, is also the name of one of the first union organizers for mineworkers. Which lends a different twist to the "tired science fiction cliché" so quickly dismissed by "Big John."

I didn't include the wording on the stone because I think there are two versions of the song. The most common one is the one you mentioned: "At the bottom of this mine lies a big, big man: Big John." But I'd swear I heard a different version once, that was probably not allowed on the air in 1961: "At the bottom of this mine lies one hell of a man: Big John."

I like the first one better, myself.

DOUG LARSEN

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Dear Dr. Schmidt:

I imagine that you will be hearing about Doug Larsen's "Big John" from many of your readers. Except for the science fiction/time travel element, "Big John" is a rehash of a popular record of the same name, from the 1950s. The details of the story are even the same.

Was the author spoofing the old song? I hope I am not so lacking in humor that I missed the point? Is there a story—real, or legendary—that serves as the root of both the song and the story? Was the lead character time traveling back to the fictitious world of a novelty record?

Whatever the explanation, even the most basic freshman composition courses teach that it is essential to always credit the source of your material. Failure to do so results in a charge of plagiarism. I like *Analog,* and hate to think of it being used that way. Please—say it ain't so.

MARTY GILL

The author replies. . . .

With all due respect to your freshman composition courses, *Analog*'s policy is different. In short, it's as follows: As long as Stan knows the source, it's not necessary to state it in the work, but if someone asks, then by all means tell them.

I wasn't spoofing the old song. I love the old song. The song was about the legend of Big John. My story was about one possible human origin of the legend. I added many elements to it: time travel, a love story, a fictitious future, a comparison of labor conditions then and in the future, an examination of the usefulness of unions today, the throes of a man trying to justify his life's work to himself, and a look at how a legend becomes born from a very human beginning. The song was the inspiration for the story, but the story treats it very differently.

DOUG LARSEN

Dear Stan,

Many thanks for giving us Bud Sparhawk's neat Jupiter sailing yarn "Primrose and Thorn." I thought the characterization was interesting and the descriptions of the Jovian atmosphere touched that sense of wonder feeling.

That said, I have a couple of comments and a minor quibble.

First, some may have missed Bud's assumption that the "keels" on his balloon ships hang down into an air mass that is moving at a different velocity than the one in which the main body floats, though he made that fairly explicit with his description of the "sea" anchor of one of the floating stations. The ribbon keels, having an aerodynamic shape, could exert a force sideways to the relative air mass movement, like a kite or a centerboard, while being dragged through the lower air mass rather than the simple resistance of a sea anchor.

The existence of such vertical velocity differences in the Jovian atmosphere, analogous to Earth's jet streams, is, I think, an acceptable speculation. Indeed (round-the-world balloon racers note!) if Bud's technique works in the Jovian atmosphere, it should work here. Jupiter's gravity has two and a half times the

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compressive force as ours, but its atmosphere is almost all hydrogen—and a column of hydrogen, even at 2.5 gees, only weighs about half what a column of nitrogen does on Earth.

Jupiter's atmosphere thus loses density with altitude at only about half the rate Earth's does, giving it the larger vertical scale.

Second, I think Bud's view that reasonably conditioned Earth people should have no great problem moving around in Jovian gravity was quite well taken. As anyone who has watched circus acrobats perform knows, properly conditioned human beings can stand and move around (or even juggle!) under two or three times their own weight without great difficulty—and Jupiter gravity only adds one and a half times his weight. Our skeletons and muscles evolved to handle the peak loads of jumping, running, carrying heavy loads like rocks and other people, fighting other big animals, and other survival problems—not just walking around. The couch potato is not the standard.

My quibble is with being able to see stars and a half-Jupiter at the same time. At synchronous orbit, Jupiter subtends an angle of about 60 degrees. That's 120 times the apparent diameter of a full Moon, or 14,400 times the apparent area of the full Moon. Since Jupiter is five times as far from the Sun, it only gets 1/25 as much light per unit area as the Moon (inverse square law)—but it reflects about four times as much per unit area (albedo), so it ends up about 1/6 the brightness per unit area of the full Moon. Take that all together and a full Jupiter from synchronous orbit should be an illumination source some 2,400 times as bright as the full Moon from Earth—and, with some allowance for curvature, limb darkening, cloud shadows and other second order effects, the half-Jupiter described in the story would be maybe 800 times as bright. That's enough to make the irises of anyone's eyes contract a bit—and only the very brightest stars could be seen.

Anyway, the story was lots of fun. I want to go there.

G. David Nordley

The author replies. . . .

Thank you for your comments on "Primrose," I especially appreciate your "sense of wonder" comment.

Unfortunately, the "Primrose And Thorn" story was written long before the Jupiter probe gave us so much information on the atmosphere, but what the hell—it's SF!

In the story I posited that the ships would operate between two highly separated layers of the atmosphere (the P12 layer). Each of these have very different viscosity's and densities, as Pascal explained to the elevator operator. It is the action of keel pressing against the heavier, slower-moving layer, while the sail works the wind that gives *Primrose* its maneuverability.

While it is exciting to think of the possibility, I do not think the design would work with Earth's balloons. Earth's atmosphere is not sufficiently vertically differentiated to enable the keel and sail combination, even at the jet stream level. Remember, the bal-

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loon has to be able to tack *against* the wind, which requires resistance from the keel. A pity, but then, we have several nice oceans to sail.

Finally, you probably don't know this but your ideas on surface gravity, during our conversation in San Francisco in 1993, told me that the characters would be able to move around in Jupiter's gravity field. Thanks for the help, even if you didn't realize it.

Lots of other quibbles you could have made—the temperatures, the intense radiation, the ability of Pascal through the murk, and the fact that the cover picture had nothing to do with the description in the story. I also had a comment about "Jupiter's cold, cold heart" in the story, only to find out that at 600 miles into the atmosphere the temperature is above 3,000 degrees!

Again, thanks for the comments and I am glad that you enjoyed the story.

BUD SPARHAWK

Dear Mr. Schmidt:

Thank you for your editorial "Unlicensed Practice." As a former and potential patient, as well as a Registered Nurse, I agree that medical decisions should be made by doctors, not bookkeepers. The money people pay for insurance premiums is paying salaries and compensation as high as what Leonard Abramson, C.E.O. of U.S. Healthcare, received in 1993, which was $805,122,045.00.

Another area that has suffered from greed is hospital care. Over the last couple of years U.S. hospitals have laid off thousands of RNs, replacing them with unlicensed personnel with as little as 16 hours of training. My hospital doubled the number of patients the RNs on two floors were responsible for. Pharmacists have been replaced by techs, medical technicians by phlebotomists.

One unlicensed nursing person put blankets on a patient shivering while receiving a blood transfusion, not realizing that a life-threatening transfusion reaction was occurring.

My association, the California Nurses Association, has gathered signatures to qualify a Patient Protection Act for the November ballot that will make illegal the practices of HMOs we consider dangerous to patients. I'm sending you a summary as well as the full text.

On May 10, 1996, thousands of nurses—RNs, LVNs, and LPNs—demonstrated on the steps of the Capitol in Washington, D.C. Nurses care about people and it hurts us to deny care because we have too many patients to care for or see patients hospitalized when their illness should have been treated early on an outpatient basis.

Thank you, Mr. Schmidt.

KATHY CARDER, R.N.
Venice, CA

Dear Dr. Schmidt:

We doctors noticed five years ago that insurance company clerks were determining what treatment or amount of treatment was "medically necessary." At that time the patient at least had the option of continuing care on his/her own.

Today most insureds are already en

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rolled in HMOs that directly employ all the doctors and staff, where non-doctors set the rules about what treatments (even prescriptions!) will be given. This employment trend is progressing very rapidly and the majority of patients are now HMO captives. The remaining insurance companies give their insureds lists of "approved" independent treating doctors. However, any doctor who "overutilizes" is quickly dropped from the list! There is a declining number of non-captive patients, shrinking fees, gag orders, and excessive paperwork and interference. Increasing numbers of doctors are simply quitting practice. I can report to you that it is expected that about 50% of all chiropractors will be going out of business within three years. This is while the executives of the insurance companies are paying themselves obscenely huge bonuses. Patients are rapidly losing choice and control of their health care.

SCOTT JORGENSON, DC
Sun City West, AZ

Dear Stan,

This matter is of small importance to anyone but me. However, I'd like to set the record straight, and would appreciate it if you can find space in Brass Tacks.

Way back in 1973, the first annual John W. Campbell Memorial Award for best science fiction novel of the year was presented. I wrote a protest, which appeared in *Analog*. Not for one moment did I question the sincerity of the founders in wishing to honor John's memory, the integrity and competence of the judges, or the literary quality of the work they chose. I did feel that the effect was to reward and promote a kind of science fiction that was the opposite of what he had always striven for.

Obviously the field should not remain static, forever locked into one set of motifs and attitudes. John himself revolutionized it in his day. Obviously, too, there is nothing intrinsically wrong with stories that are technophobic, psychologically involuted, completely cut off from any roots in real science, or otherwise non-Campbellian. Many of them are very fine, and certainly they add to the variety and thus the vitality of our literature. By all means give them recognition. My feeling was simply and strongly that this should not be done in the name of John W. Campbell, and I suggested calling the award something else.

A few people agreed with me, probably more disagreed, and nothing changed. It was, at most, a teapot tempest, which soon blew over. I myself pretty much forgot about it and paid no particular attention to the announcements thereafter.

Recently, though, two of the current judges, James Gunn and Paul Carter, were kind enough to give me a rundown of the history, with a list of all the winners. It became clear to me that the trend is no longer anti-Campbellian, and has not been for a considerable time—if, indeed, it ever was. Of course, those winners are diverse, and doubtless John would have rejected some, but many more looked as though they would have pleased him. As for those that would not, well, as

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said before, doctrinaire rigidity would itself be against everything he stood for. I hereby withdraw my objections.

Yes, this is rather like Margaret Fuller grandly declaring, "I accept the Universe." (To which Thomas Carlyle was heard to mutter, "Gad! She'd better.") But another of John's ideals was honesty.

POUL ANDERSON

Dear Dr. Schmidt:

I hope that my fellow readers of *Analog* can help solve a literary/historical mystery. I am attempting to identify a device described in a story by Robert Heinlein, which was subsequently developed for use by the U.S. Navy during World War II. Ginny Heinlein does not know the answer, nor do the surviving members of Heinlein's Naval Academy class of 1929. An examination of his stories between August 1939 and December 1941 suggest some possibilities but nothing definite. The best lead is that it might be related to work done in developing the Combat Information Center (CIC) principle by a classmate and close friend of Heinlein, Caleb Laning (1906-1991).

The parameters of the search are contained in *Grumbles from the Grave* in letters dated 21 December 1941 and 4 January 1942, and in the Heinlein essay "Science Fiction: Its Nature, Faults and Virtues." An article containing details of my search, "The Great Heinlein Mystery," appeared in the January-February 1995 issue of *Shipmate,* the magazine of the U.S. Naval Academy Alumni Association. This article produced few responses and no useful information.

I am continuing to present my search to audiences familiar with naval engineering and naval history. At the same time, I would like to see if a science fiction oriented audience could provide the answer. The odds (18 out of 22 stories) favor the answer lying somewhere in the pages of *Astounding*. So it seems a good idea to present the question to the readers of *Analog*. Perhaps there is someone who once obtained the answer directly from Robert Heinlein. I would appreciate hearing from anyone who has *definite* information. Please, no "I think that it is. . . ."

EDWARD M. WYSOCKI, JR.
3956 Town Center Blvd. #247
Orlando, FL 32837

Dear Editors:

There is another "simple" method of interstellar propulsion not mentioned in Gregory L. Matloff's excellent article, "Voyage to the Sun's Gravity Focus." I call it passive nuclear propulsion, and I can't believe that I am the only person ever to think of it. It works as follows: Coat one side of your solar sail with an alpha-particle emitting element. (Radium paint!?) Then, as atoms undergo alpha decay, some of the He nuclei will provide impulse thrust, while the ones which happen to exit the nucleus in the wrong direction will be stopped by the mylar (or whatever) and no net momentum transfer will occur from them. A back-of-the-envelope calculation indicates that a hypothetical 5-MeV alpha emitter with a 1,000 year half-life, if it made up half the mass of

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the craft would provide a net acceleration of the order of one kilometer per second per year. This is a few orders of magnitude less than the light pressure acceleration near the Sun, of course, but it would continue fairly constant for centuries. A few decades, even with no help from light pressure or planetary gravity or anything else, would suffice to reach Solar System escape velocity.

If it is feasible to use nuclides which undergo multiple, successive alpha decays, before turning to lead, the available energy improves by an order of magnitude, more or less.

I would be interested in any comments/critiques.

DAVID P. BELLAMY
bellamy@math.udel.edu
P.O. Box 456
Newark DE 19715-0456

The author replies. . . .
Dear Stanley,

I am gratified that David P. Bellamy enjoyed my science fact article in the April 1996 *Analog*, "Voyage to the Sun's Gravity Focus: The First Starship?" His query regarding propulsion by alpha-emitting radioisotopes deposited on one side of a solar sail is thoughtful and worthy of response.

Although the concept has perhaps been understudied, at least two researchers have considered such a propulsion scheme. Writing in the April 1977 issue of *AIAA Journal*, W. E. Moeckel of NASA Lewis coined the term "thrust-sheet propulsion" for thin-film radioisotope space drives. He investigated two candidate isotopes: polonium-210 with a half-life of 138 days and californium-254 with a half-life of about 60 days. A polonium-210 sail might be able to accelerate a sail craft to a maximum velocity of about 400 km/sec. A californium-254 thrust-sheet could do better because spontaneous fission might be possible for this isotope. Thrust-sheet problems discussed by Moeckel include payload shielding, radioisotope producibility and cost, radiation-effects upon thin-film integrity, and sail construction/deployment. An Earth-launched thrust-sheet is perhaps not very likely because the folded sail might heat up too much during pre-launch preparation and launch-pad holds. It would probably be necessary to deposit the radioactive layer on the sail in orbit.

In the *Proceedings* of the August 1994 conference on robotic interstellar travel (cited in my April 1996 article), Bob Forward also considered thrust-sheet propulsion using isotopes of polonium, thorium, uranium, and plutonium. Forward believes that this propulsion technique is limited by the amount of substrate required to absorb half of the alpha particles (necessary for a net thrust). This may reduce maximum velocity of a thrust sheet to only 30 km/sec, at least for the isotopes considered.

The fact that there are apparent problems with thrust-sheet propulsion should not deter David Bellamy from further investigating this possible interstellar propulsion scheme. After all, *he* may be the one to overcome the technical and (rather obvious) environmental objections!

GREGORY MATLOFF ■

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UPCOMING EVENTS Anthony Lewis

31 October–3 November
WORLD FANTASY CONVENTION at Hyatt Regency Woodfield, Schaumburg, IL. Guests of Honor—Katherine Kurtz, Joe R. Landsale; TM—Brian Lumley. Registration: $90 until 1 September, $100 thereafter; $25 supporting. Info: WFC 1996, Box 473, Oak Forest, IL 60452.

8–10 November
ORYCON 18 (Oregon SF conference) at Red Lion/Columbia River, Portland, OR. Guests of Honor—Diane Duane & Peter Morwood (writers), Gardner Dozois (editor), Patricia Davis (artist). Registration: $25 until 31 October 1996. Info: OryCon 18, PO Box 5703, Portland OR 97228-5703. Phone: (503) 283-0802. E-mail: orycon.18@genie.com or OryCon18@aol.com URL—http://www.teleport.com/~osfci/orycon18/

8–10 November
CON*STELLATION XV: AQUILA (northern Alabama area SF conference) at Tom Belvill Center, Huntsville, AL. Guest of Honor—Stanley Schmidt; Fan Guest of Honor—Chloie Airoldi; TM—Rick Cook. Registration: $25 until 15 October, $30 thereafter. Info: Con*Stellation XV, Box 4857, Huntsville, AL 35815. Phone: (205) 883-5922 or (205) 461-3064. E-mail: constell@iquest.com URL http://iquest.com/~ssmith

22–24 November
PHILCON 61 (Philadelphia area SF conference) at Adam's Mark Hotel, Philadelphia, PA. Guest of Honor—Frederik Pohl. Registration: $25 until 17 November. Info: Philcon 61, c/o PSFC, Box 8303, 30th Street Station, Philadelphia, PA 19101. Phone: (215) 957-4004. E-mail: philcon@cyber.com

28 August–1 September
LONESTARCON 2 (55th World Science Fiction Convention) at San Antonio Convention Center, San Antonio, TX. Guests of Honor—Algis Budrys and Michael Moorcock; Artist Guest of Honor—Don Maitz; Fan Guest of Honor—Roy Tackett; TM—Neal Barrett, Jr. Registration until 7 July 1996 $95; supporting $25; children 3-12 $40; children 0-3 FREE (age as of 28 August 1997). This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Info: LoneStarCon 2, Box 27277, Austin, TX 78755-2277. Phone: (512) 435-7446 (voice), (512) 435-7747 (fax), E-mail: lsc2@io.com

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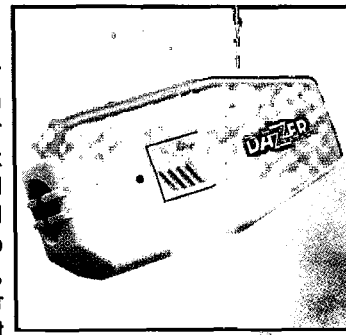

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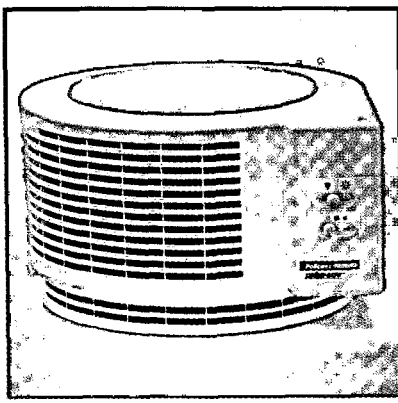

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